

TECHNICAL SPECIFICATIONS PACKAGE FOR FLINT RIVER PUMP STATION UPGRADE IFB-XXXX



Atlanta, Georgia

**Andre P. Dickens
Mayor
City of Atlanta**

**Greg Eyerly
Commissioner**
Department of Watershed Management

**Chandra Houston
Interim Chief Procurement Officer**
Department of Procurement

FLINT RIVER PUMP STATION UPGRADE IFB-XXXX

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Andre P. Dickens

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Greg Eyerly

Commissioner

Department of Watershed Management

Chandra Houston

Interim Chief Procurement Officer

Department of Procurement

**INVITATION TO BID
FOR
IFB-XXXX**

FLINT RIVER PUMP STATION UPGRADE

ISSUED FOR BID – June 2022



ATLANTA, GEORGIA

**Andre P. Dickens
Mayor**

**Greg Eyerly
Commissioner
Department of Watershed Management**

**Chandra Houston
Interim Chief Procurement Officer
Department of Procurement**

INVITATION TO BID

Insert by Others

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FLINT RIVER PUMP STATION UPGRADE

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INSTRUCTIONS TO BIDDERS

PART I

INSTRUCTIONS TO BIDDERS

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FLINT RIVER PUMP STATION UPGRADE

GENERAL CONDITIONS

GC-1 AGREEMENT AND AGREEMENT DOCUMENTS

The General Conditions, Special Conditions, Technical Provisions, Drawings, Changes, and all other parts of the Agreement Documents are complementary, and a requirement occurring in one shall be as binding as though occurring in all. The parts of the Agreement are complementary and describe and provide for completion of the Work. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said documents are solely to facilitate reference to various provisions of the Agreement Documents and in no way affect, and shall not be considered in the interpretation of the provisions to which they refer.

Execution of the Agreement by Contractor is a representation that Contractor has visited the Site, become familiar with the local conditions under which the Work is to be performed, and has correlated personal observations with the requirements of the Agreement Documents.

The intent of the Agreement Documents is to include all items necessary for the proper execution and completion of the Work. Work not specifically covered in the Agreement Documents shall be required if it is consistent therewith and reasonably inferable therefrom as being necessary to produce the intended results. Words and abbreviations that have well-known technical or trade meanings are used in the Agreement Documents in accordance with such recognized meanings.

If and to the extent of any inconsistency, ambiguity, conflict, discrepancy or error in the Agreement Documents (a "discrepancy"), Contractor shall immediately notify the Owner in writing and seek clarification from the Owner (within 24 hours of discovery). In the event that the Owner fails to clarify such discrepancy within a reasonable time under the circumstances, Contractor shall proceed with the Work and give precedence to the Agreement Documents in the following order of priority:

- (1) Written modifications (including without limitation Change Orders and Change Directives) issued after execution of the Agreement;
- (2) Addenda issued in writing prior to the execution of the Agreement;

- (3) The Agreement;
- (4) Addendum, if any, to the General Conditions and Special Conditions;
- (5) Special Conditions;
- (6) The General Conditions;
- (7) The Specifications; and
- (8) The Plans and Drawings.

If the application of the foregoing procedure fails to resolve the discrepancy, then unless Contractor sought and obtained the clarification of the discrepancy prior to entering into this Agreement, then the discrepancy shall be resolved by construing the provision in favor of the Owner and in such a manner as will further the Owner's best interests and which may impose the more expensive or greater obligation upon Contractor. When Contractor fails to provide this notice and seek clarification, Contractor assumes full responsibility to correct or adjust work performed pursuant to Agreement Documents known, or which should have been known, to contain such a discrepancy.

GC-2 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

During the progress of the Work, the Engineer may issue additional instructions and Drawings supplemental to those listed in the Special Conditions showing additional details required for the performance of the Work, and may issue revised Drawings pursuant to Change Orders or Change Directives or for correction of errors in the Plans. The additional instructions and Drawings thus supplied will become a part of the Agreement Documents. Contractor shall carry out the Work in accordance with the additional instructions and Drawings.

GC-3 DEFINITIONS

The following terms as used in this Agreement are respectively defined, as follows:

Abandonment - Shall mean the permanent termination of the use of, or of service from in or on, a facility.

Approved, Directed, Ordered, Or Their Derivatives - Approved, as directed, or ordered by the Engineer or the City, unless otherwise clearly indicated.

Acceptance - The formal written acceptance by the City of the fully and finally completed Work.

Addenda - Revisions to the Proposal Documents issued by the City prior to opening of the Bid.

Agreement - The written agreement for the performance of and payment for the Work, which includes by reference and is a part of the Agreement Documents, executed on behalf of the City and the Contactor, also called City-Contractor Agreement.

Agreement Documents - The Agreement Documents are defined in other portions of the Agreement, but include, at least, the following, if applicable to this Project:

- This City-Contractor Agreement;
- General Conditions (Part I);
- Special Conditions (Part II);
- Scope of Service (Part III);
- Equal Business Opportunity Program (Appendix A);
- Insurance and Bonding Requirements (Appendix B);
- Disclosure Form and Questionnaire (Appendix C);
- LOCAL Bidder Preference Program (Appendix D);
- Georgia Security and Immigration Compliance Act of 2006 (Appendix E);
- Bid Schedule (Exhibit A);
- Required Submittals (Exhibit B);
- Addendum (Exhibit C);
- Legislation (Exhibit D); and
- Performance and Payment Bonds

The Agreement Documents may also be referred to from time to time as the “Contract Documents.”

Agreement Price - The price or prices for the Work or items of Work set forth in the Bid.

Agreement Time - The number of calendar days stated in the Agreement Documents for the Substantial Completion of the Work or Final Completion of the Work, or the achievement of a specific interim milestone, as the context may require.

Applicant - Shall mean any person, company or corporation who intends or plans to request for water services for a new development.

Application for Payment - The form approved by the City that is to be used by Contractor in requesting progress payments or final payment, together with such supporting documentation as is required in the Agreement Documents. The Application for Payment may also be called Payment Application or Progress Payment.

Bid - The offer or bid of the Bidder submitted in the prescribed manner on the prescribed form setting forth the prices for the Work to be performed together with supplemental information as required by the Agreement Documents.

Bidder - Any person, firm, partnership, corporation or any combination thereof submitting a Bid for the Work.

Bonds - Bid, Performance Bonds, Payment Bonds, and other instruments of security furnished by Contractor and its surety in accordance with the Agreement Documents. Bond means a written instrument of surety approved by the City with a valid Certificate of Authority issued by the United States Department of Treasury under Sections 9304 to 9308 of Title One of the United States Code as security to the City, on behalf of a Bidder or the Contractor, to guaranty faithful performance of acts, duties or obligations under the Contract Documents and includes the following.

- Bid Bond means the security instrument furnished with a Bid to guaranty that, if the Bidder is awarded the Contract, the Bidder will execute the Agreement within the time specified in the Bidding Documents.
- Maintenance Bond, if required on the Project, means the security instrument furnished by the Contractor and its surety on the approved form as a guaranty, in addition to other warranties and guaranties, to remedy any defects in the Work of the Contractor which may develop during the warranty period after Completion of the Contract.
- Payment Bond means the security instrument furnished by the Contractor and its surety on the Payment Bond Form as a guaranty that Contractor will pay in full all bills and accounts for materials and labor used in the Work.
- Performance Bond means the security instrument furnished by the Contractor and its surety on the Performance Bond Form as a guaranty that the Contractor will complete the Work in accordance with the terms of the Contract.

Change - Any change in the Work authorized by the Engineer, including Field Changes, Work Authorizations or Change Orders.

Change Directive – A written order prepared by the Owner and signed by the Owner directing a Change in the Work prior to or absent an agreement or adjustment, if any, in the Agreement Price or Agreement Time, or both.

Change Order - A written agreement signed by the Owner and Contractor, stating their agreement upon all of the following: (1) change in the Work that includes the addition or reduction of Work; (2) the amount of the adjustment, if any, in the Agreement Price; and (3) the extent of the adjustment, if any, in the Agreement Time and includes at least one of the above Changes. A Change Order does not include a Field Change, Work Authorization or Change Directive.

City - Shall mean the City of Atlanta, Georgia, and shall include all agencies, establishments or officials of the government of the City. The City may also be referred to from time to time as the "Owner."

City-Contractor Agreement - The written agreement for the performance of and payment for the Work executed on behalf of the City and the Contractor, which is both a part of the Agreement Documents and includes all Agreement Documents by reference. The City-Contractor Agreement may also be called "Agreement."

City's Contractor - Shall mean the legally authorized representative of the City, a private contractor, or other concerned agency performing Work under a direct Agreement with the City.

Construction - Shall mean the actual site preparation, building and all related Work, including facility relocation and adjustments.

Construction Easement/Temporary Easement - Any space or area dedicated to the City or other entity for the purpose of utilities or location of utilities for a specific period of time.

Construction Equipment - Equipment used in the performance of the Work but not incorporated therein.

Contract Documents - The Agreement Documents referenced above.

Contractor - Any firm, partnership, corporation, joint venture, LLC or any combination thereof who enters into a contractual Agreement with the City. This excludes Subcontractors/Sub-consultants.

CPM Schedule – A logic tied computerized network schedule incorporating all elements of the Work, prepared and updated in accordance with the requirements of the Special Conditions, subject to approval of the City.

Day - A calendar day of twenty-four (24) hours lasting from midnight one day to midnight the next day.

Department - Shall mean the Department of Watershed Management.

Designer - Shall refer to the firm licensed to practice engineering in the State of Georgia that seals the plans and specifications prior to bid.

Drawings - That part of the Agreement Documents which show the shape, outlines, dimensions, characteristics, scope of and other similar requirements governing the Work, or portions thereof, prepared by the Designer and including revisions thereto. The term is used interchangeably with the word "Plans" and includes without limitation Standard Details and Drawings.

Engineer - City of Atlanta or duly authorized representative assigned to administer the technical aspects of the Agreement. The terms Resident Engineer, Contract Administrator, or Contract Manager may be used interchangeably to denote the person designated expressly by the City with authority to administer the Agreement.

Equipment - Equipment incorporated or to be incorporated in the Work.

Field Change – A Change in Work that includes changes or adjustments to quantities or budget items but does not include a Change in the overall Agreement Price, overall Agreement Time or use of allowance items, which is required as a result of field conditions that require such adjustments. A Field Change does not include a Work Authorization, a Change Order or a Change Directive and is agreed upon and executed by an authorized City representative and the Contractor.

Force Account - A method of payment, other than lump sum or unit price, for Work ordered by Change Order and paid for in accordance with force account procedures indicated in “Force Account” Section of the General Conditions.

General Conditions - The General Conditions of the Agreement for construction that govern the rights, duties, and obligations of the parties.

GDOT - The Georgia Department of Transportation.

Inspector - The authorized representative of the Engineer or the City assigned to make detailed inspection of any or all portions of the Work or Materials thereof.

MARTA - Shall mean the Metropolitan Atlanta Rapid Transit Authority, or its designated legal representatives.

Materials - Materials incorporated or to be incorporated in the Work unless otherwise clearly indicated.

Modifications – Binding changes, addenda, revisions, or the like, to the Work or the Agreement Documents, including Changes to Work made by Change Order, Work Authorization, Field Change or Change Directive as required by GC-41.

Notice of Intent or Letter of Intent to Award - The written notice of the acceptance of the Bid from the City to a Bidder.

Notice to Proceed - (“NTP”) Written communication issued by the City to Contractor authorizing it to proceed with the Work and establishing the date of commencement of the Agreement time and on which Contractor shall start to perform its obligations in accordance with the Agreement Documents.

Owner - Same as “City” above.

Permanent Easement - Any space or area dedicated to the City or other entity for the purpose of constructing and/or maintain existing or future utilities.

Plans - That portion of the Agreement Documents describing in drawings, the shapes, outlines, dimensions, characteristics, scope and other similar requirements governing the Work, or portions thereof, prepared by the Designer and including revisions thereto. The term is used interchangeably with the word "Drawings" and includes without limitation Standard Details and Drawings.

Project - The Project is identified in the City-Contractor Agreement and is the total construction of which the Work performed under the Agreement Documents is a part.

Public Space/Public Right-of-Way - Shall mean the area between private property lines under the jurisdiction of the City, county, state or federal government, including, but not limited to, an alley, roadway, median, sidewalk, public way, or any combination thereof.

Punch List - Shall mean the lists prepared by the City's Representative or Design Consultant prior to Substantial Completion and through Final Completion indicating items of Work not in accordance with the requirements of the Contract Documents and which must be performed, corrected and accomplished prior to acceptance of the Work.

Replacement Facility - Shall mean that facility, meeting the Department's current standards, which will be constructed or provided, as a consequence of the rearrangement of an existing facility or portion thereof.

Resident Engineer - The City's Engineer who is assigned to the Site or any part thereof.

Responsive Bid - A Bid which is accurate and complete with respect to Bid schedules and information submitted relative to the technical qualifications and financial responsibility and is able to comply with Equal Opportunity and other requirements of the Agreement Documents.

Samples - Shall mean physical examples furnished by Contractor, which illustrate materials, equipment or workmanship. Approved Samples in conformance with the Contract Documents establish the standards of the Work.

Shop Drawings - Shall mean drawings, diagrams, illustrations, schedules or other data illustrating the Work, and all illustrations, brochures, standard schedules, performance charts, specifications, instructions, diagrams, and other information prepared by a Subcontractor, Supplier, vendor or manufacturer and submitted by Contractor as required in the Contract Documents.

Scope of Services - See "Work."

Sidewalk Area - Shall mean that portion of a street between the curb lines and the adjacent property lines intended primarily for the use of pedestrians whether paved or in use.

Site - The areas required for the performance of the Work.

Special Conditions - Terms which supplement items covered in General Conditions.

Specifications, Technical Specifications - Shall mean those portions of the Contract Documents consisting of written technical descriptions, provisions or requirements of the Work to be performed under the Contract Documents, including, but not limited to, the quantities or quality of materials, equipment, construction systems or applications. Standards for specifying materials or testing that are cited in the Specifications are part of the Contract Documents.

Standards - Shall mean those current Standards of Engineering analysis and design, including Installation and Material Specifications, which the City utilizes in the design and construction of its own projects.

State - The State of Georgia.

Subcontractor - An individual, firm, corporation or any combination thereof having a direct contract with Contractor for the performance of a part of the Work at the site.

Substantial Completion - The date certified by the Engineer when all or a part of the Work, identified in the Engineer's certification, is sufficiently completed in accordance with the requirements of the Agreement Documents so that the identified portion of the Work can be utilized for the purposes for which it is intended.

Supplier - Any individual, firm, or corporation who supplies Material or Equipment for the Work (including that fabricated to a special design) but who does not perform or provide significant labor at the Site.

Temporary Facility - Shall mean a facility constructed for whatever purpose and not intended to be permanent.

Utility - Shall mean and include all public, private, or cooperatively owned lines, facilities and systems for producing, transmitting or distributing communications, power, electricity, heat, gas, oil, crude products, water, steam, waste, storm water, and other similar commodities, such as public owned fire and police signal systems, which directly or indirectly serve the public or any part thereof.

Work - All the services specified, indicated, shown, or contemplated by the Agreement Documents and the furnishing by Contractor of all Materials, Equipment, labor, methods, processes, construction and manufacturing materials and equipment, tools, plants, supplies, power, water, transportation and other things necessary to complete

such services in accordance with the Agreement Documents and that will ensure a functional and complete facility.

Work Authorization – A Change in Work that adds, changes or removes scope of work from the Agreement but does not include a change in Agreement Time or Agreement Price; or the utilization of an allowance or contingency item, as permitted and defined by the Agreement documents. A Work Authorization does not include a Change Order, a Field Change or a Change Directive and is agreed upon and executed by an authorized City representative and the Contractor.

Working Days - Generally, Monday, Tuesday, Wednesday, Thursday, and Friday; however, on some projects, Saturday and/or Sunday may be considered working days, if specified as working days by the City or Engineer. Holidays are not considered Working Days.

Written Notice - A written statement transmitted from one party to an authorized representative of another party.

GC-4 APPLICABLE CODES, SPECIFICATIONS, AND STANDARDS

GC-4.1 General

All codes, Specifications, regulations, laws, ordinances, and standards referred to in the Agreement Documents shall mean, and are intended to be, the latest editions, amendment, and revisions of such reference standard in effect as of the date of the Invitation to bid for this Agreement, and as may be updated or amended to be applicable to the Project.

GC-4.2 Standards

Reference to a technical society, institution, association, or governmental authority, or pronoun in place of them, is made in the Agreement Documents in accordance with the following abbreviations:

ANSI	American National Standards Institute;
ASTM	American Society for Testing and Materials;
AWS	American Welding Society;
AASHTO	American Association of State Highway and Transportation Officials;
ACI	American Concrete Institute;
AFBMA	Anti-Friction Bearing Manufacturer's Association;
AI	Asphalt Institute;
AISI	American Iron and Steel Institute;
AISC	American Institute of Steel Construction;
AMCA	Air Moving and Conditioning Association;
API	American Petroleum Institute;
ASME	American Society of Mechanical Engineers;

ASTM	American Society for Testing and Materials;
AWG	American (Brown and Sharpe) Wire Gauge;
AWS	American Welding Society;
AWWA	American Water Works Association;
CRSI	Concrete Reinforcing Steel Institute;
EPA	Environmental Protection Agency (Federal);
EPD	Environmental Protection Division (Georgia State);
GDOT	Georgia Department of Transportation (“GDOT”);
MARTA	Metropolitan Atlanta Rapid Transit Authority;
NACE	National Association of Corrosion Engineers;
NFPA	National Fire Protection Association;
NSF	National Sanitary Foundation;
OSHA	Occupational Safety and Health Administration; and
UL	Underwriter’s Laboratories Incorporated.

GC-5 ADEQUACY OF DESIGN

Before placing its Bid to the City, and continuously after the execution of the Agreement, Contractor shall carefully study and compare the Agreement Documents and shall at once report any error, ambiguity, inconsistency or omission that may be discovered, including any requirement which may be contrary to any law, ordinance, rule, regulation, or order of any public authority bearing on the performance of the Work. By submitting its Bid for the Agreement and the Work under it, Contractor agrees that the Agreement Documents, along with any supplementary written instructions issued by or through the Engineer that have become a part of the Agreement Documents, appear accurate, consistent, and complete. Contractor shall perform no portion of the Work at any time without Agreement Documents or, where required, approved shop Drawings, product data, or samples for such portion of the Work.

No claims shall be made by Contractor based on claims of defects, errors, omissions, ambiguities or inconsistencies in the Agreement Documents which were reasonably discoverable by a review of the Agreement Documents and correlation thereof with the actual conditions at the Project Site. No observation of the Engineer or City, and no inspections, tests or approval shall relieve Contractor from its obligation to perform the Work in strict conformity with the Agreement Documents.

Contractor has determined, by its own investigation and research, all the conditions affecting the work to be done and materials to be furnished and does not rely upon any representation by the City in connection therewith.

THE CITY, ITS AGENTS AND EMPLOYEES MAKE NO REPRESENTATION OR WARRANTY OF ANY NATURE WHATSOEVER TO CONTRACTOR CONCERNING THE AGREEMENT DOCUMENTS. By the execution hereof, Contractor acknowledges and represents that it has received, reviewed and carefully examined such documents, has found them to be complete, accurate, adequate, consistent, coordinated and sufficient for construction, and that Contractor has not, does not, and will not rely upon

any representations or warranties by the City concerning such documents as no such representations or warranties have been or are hereby made.

Prior to execution of the Contract, Contractor has evaluated and satisfied itself as to the condition and limitations under which the Work is to be performed, including, without limitation, (i) the location, condition, layout, and nature of the Project Site and surrounding areas, (ii) generally prevailing climatic conditions, (iii) anticipated labor supply and costs, (iv) availability and cost of materials, tools and equipment, and (v) other similar issues. With the exception of any differing site conditions clause, if any, that may be included in the Agreement Documents, the City assumes no responsibility or liability for the physical condition of the Project Site, or any improvements located on the Project Site. Contractor shall be solely responsible for providing a safe place for the performance of the Work.

Contractor acknowledges and agrees that its obligation to construct the Work in accordance with the Agreement Documents is not in any way altered or affected by the observations or inspections of the City or the Designer. Further, Contractor acknowledges and agrees that any warranty periods included herein merely set forth the time period during which Contractor is contractually required to specifically perform corrective work and that these warranty periods are not and shall not be construed to be exclusive remedies of the City. Instead, Contractor acknowledges and agrees that it shall be liable to the City for the cost of correcting Work not performed in accordance with the Agreement Documents for the full period of the applicable statute of limitations.

GC-6 CITY OF ATLANTA ORDINANCES

Contractor shall be bound by the provisions of all City of Atlanta Ordinances. It is Contractor's responsibility to be aware of and adhere to all existing or future ordinances that are in effect during the performance of the Agreement.

GC-7 PERMITS AND REGULATIONS

All applicable federal laws, state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Agreement throughout to the extent that such requirements do not conflict with federal laws or regulations and in the event of a conflict, federal laws shall govern. All Work performed within the right of way of GDOT shall be in accordance with GDOT regulations, policies, and procedures.

Except as expressly stated in the Contract Documents, Contractor shall secure and will provide all building permits, licenses, and other applicable legal documents required for Contractor's performance of the Project.

Contractor shall give all notices and comply with all permits, laws, ordinances, rules and regulations bearing on the conduct of the Work as drawn and specified.

If any permit, license or certificate expires or is revoked, terminated or suspended as a result of any action on the part of Contractor or any person or entity for which Contractor is responsible, it shall neither be entitled to any additional compensation, nor to an extension of Agreement Time.

GC-8 TAXES

Contractor shall pay all sales, retail, occupational, service, excise, old age benefit and unemployment compensation taxes, consumer, use and other similar taxes as well as any other taxes or duties on the Material, Equipment and labor for the Work or portions thereof provided by Contractor which are legally enacted by any municipal, county, federal or state authority or department or agency thereof at the time Bids are received, whether or not yet effective.

All records maintained by Contractor pertaining to such taxes and levies and payment thereof shall be made available to the City at reasonable times for inspection, audit and copying.

GC-9 ARREARS TO OFFSET DEBT AGAINST CITY

No money shall be paid by the City upon any claim, debt, demand or account whatsoever, to any person, firm, or corporation who is in arrears to the City for taxes, or any other debt or claim, and the City shall be entitled to counterclaim and/or offset any such debt, claim, demand or account in the amount of taxes so in arrears or other debts or claims of the City, and no assignment or transfer of such debt, claim, demand, or account after the said taxes are due or after any such debt or claim is asserted by the City, shall affect the right of the City to so offset the said taxes, debts, or other obligations against the same.

Contractor agrees that the City shall be allowed to setoff and recoup any claim or demand that it may have against Contractor (or any of its constituent members if Contractor is a joint venture) whether such claim or demand is liquidated or unliquidated. Contractor further agrees that in the event it assigns or sells any amounts due or to become due under this Agreement, notice to the City of such assignment or sale shall not affect the City's rights of setoff or recoupment against Contractor for claims subsequently arising on this or any other project. Any assignee or purchaser of any amounts due Contractor under this Agreement shall be bound to these provisions and shall assume the risk of subsequently arising claims of setoff or recoupment.

GC-10 LIENS

Contractor acknowledges that neither it nor any of its Subcontractors or Suppliers have lien rights on public property. Contractor will furnish the City with evidence, satisfactory to the City that all persons who have done Work or furnished materials in performance

of this Agreement have been fully paid before it shall demand final payment due or unpaid under this Agreement. In case such evidence is not furnished, an amount necessary to meet the lawful claims of the persons aforesaid may be retained from any monies due or that may become due the said Contractor under this Agreement until the lawful claims aforesaid shall be fully discharged, and it is understood and agreed that the City assumes no obligation nor in any way undertakes to pay such lawful claim out of any funds due or that may become due the said Contractor out of the City's own funds.

If, in its sole discretion, the City wishes to make joint payment to Contractor and any of its Subcontractors or Suppliers, Contractor agrees that the City may do so, and Contractor agrees to cooperate with the City in identifying the amounts due Subcontractors and Suppliers to facilitate the making of said joint payment.

GC-11 ASSIGNMENTS

Contractor shall retain personal control and shall give personal attention to the fulfillment of this Agreement. Contractor shall not assign the whole or any part of this Agreement or any monies due or to become due hereunder without the written consent of the City. In case Contractor assigns all or any part of any monies due or to become due under this Agreement, the instrument of assignment shall contain, or shall be deemed to contain, a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to Contractor shall be subject to claims of all persons, firms, and corporations for services rendered or materials supplied for the performance of the Work called for in this Agreement and to setoffs and recoupments by the City as set forth in GC-9 above. Any assignment of this Agreement in whole or in part or any assignment of monies due or to become due hereunder must bind the assignee to all terms and conditions of this Agreement and protect and preserve all rights and remedies of the City as against Contractor and extend to the City the same rights and remedies against assignee. In the event that any person or entity should claim entitlement to all or any part of any monies due or to become due under this Agreement under the doctrine of subrogation, it further agrees that its rights shall be subject to claims of all persons, firms, and corporations for services rendered or materials supplied for the performance of the Work called for in this Agreement and to setoffs and recoupments by the City as set forth in GC-9 above.

GC-12 PATENTS AND ROYALTIES

Contractor shall indemnify and hold harmless the City and its officers, agents, servants, and employees from liability or all claims of any nature or kind, including costs, attorneys' fees, and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the Agreement, including its use by the City, unless otherwise specifically stipulated in the Agreement Documents.

If Contractor uses any design, device or Materials covered by letters, trademarks, patent or copyright, it shall provide for such use by suitable agreement between the City and the holder of such design, device or Material. It is mutually agreed and understood that, without exception, the Agreement Price shall include all royalties or costs arising from the use of such design, device, or Materials in any way involved in the Work. Contractor or its sureties or both shall indemnify and hold harmless the City, its officers and employees from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or Materials or any trademark or copyright in connection with Work agreed to be performed under this Agreement and Contractor shall indemnify the City for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work, including any costs or expenses for experts and attorneys' fees.

GC-13 OUT-OF-STATE CONTRACTORS

If the lowest responsive Bidder is a foreign corporation, partnership, or sole proprietorship, the Bidder hereby irrevocably appoints the Secretary of State of Georgia as its agent for services of all legal process for the purpose of this Agreement only and shall obtain all required certificates and licenses required by the Georgia Law.

GC-14 CONTRACTOR'S OBLIGATIONS

GC-14.1 Supervision and Construction Procedures

GC-14.1.1

Contractor shall supervise and direct the Work, using Contractor's best skill and attention. Contractor shall be solely responsible for all construction means, methods, techniques, sequences and procedures and shall coordinate all portions of the Work under the Agreement. All Work under the Agreement shall be performed in a skillful and workmanlike manner. Contractor shall exercise its control over all means, methods, techniques, and procedures so as to carefully and diligently coordinate the work of all Subcontractors and Suppliers or anyone working by, through, or under Contractor or a Subcontractor or Supplier.

GC-14.1.2

Contractor shall be responsible to the City for the acts and omissions of Contractor's employees, Subcontractors, Suppliers, and their agents and employees, and any other persons performing any of the Work under a contract with Contractor or a Subcontractor or Supplier.

GC-14.1.3

Contractor shall not be relieved from Contractor's obligations to perform the Work in accordance with the Agreement Documents by the activities or duties of the Engineer in the administration of the Agreement or by inspections, tests, or approvals required or performed by persons other than Contractor.

GC-14.1.4

Contractor shall carefully study and compare the Agreement Documents with each other and with the site conditions and other information furnished by the Owner and shall at once report in writing to the Owner alleged errors, inconsistencies or omissions. If Contractor performs any construction activity involving an error, inconsistency or omission in the Agreement Documents that Contractor recognized or reasonably should have recognized and without having given written notice to the Owner, Contractor shall assume complete responsibility for such performance and shall bear the full amount of the attributable costs for correction.

GC-14.1.5

Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information available to Contractor with the Agreement Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported in writing to the Owner at once and shall be subject to the provisions of the last sentence of GC-14.1.4 above.

GC-14.2 Labor and Materials

GC-14.2.1

Unless otherwise provided in the Agreement Documents, Contractor shall provide and pay for all labor, Materials, Equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work, whether temporary or permanent, and whether or not incorporated or to be incorporated in the Work.

GC-14.2.2

Contractor shall, at all times, enforce strict discipline and good order among Contractor's employees and Subcontractors, and shall not employ on the Work any Subcontractor, unfit person or anyone not skilled in the task assigned them. The City may, after Written Notice, require Contractor to remove from the Work any employee the City deems incompetent, careless, or otherwise objectionable, including any employee of a Subcontractor or Supplier.

GC-14.2.3

All Work at the site shall be performed during regular working hours, except upon the City's written consent given after prior Written Notice.

GC-14.3 Contractor's Construction Schedule

* The following report of explorations and tests of subsurface conditions at the Site have been used by the Engineer in preparing the Contract Documents: "Design Phase Geotechnical Report" March 16, 2021 prepared by MC Squared, Inc., Kennesaw, GA. The "technical data" contained in such report upon which Contractor may rely is the basis of information for the foundation design and construction recommendations of foundations and pavements of selected areas within the existing boundary.

Contractor shall comply with all scheduling requirements set forth in the Agreement Documents, including but not limited to the Special Conditions requirements for a CPM Schedule for performance of the Work.

GC-14.4 Conditions Affecting the Work

Contractor shall be responsible for having taken all steps necessary to ascertain the nature and location of the Work and the general and local conditions that can affect the Work or the cost thereof. Failure by Contractor to fully acquaint itself with conditions that may affect the Work, including but not limited to conditions relating to transportation, handling, storage of Materials, availability of labor, water, roads, weather, topographic and subsurface conditions, as-built conditions, other separate contracts to be entered into by the City relating to this Project that may affect the Work of Contractor, applicable provisions of law, and the character and availability of equipment and facilities needed prior to and during the prosecution of the Work, shall not relieve Contractor of its responsibilities under the Agreement Documents and shall not constitute a basis for an equitable adjustment or additional compensation under any circumstances. The City assumes no responsibility for any understanding or representations concerning conditions made by any of its officers, agents, or employees prior to the execution of the Agreement, unless such understanding or representations are expressly stated in the Agreement Documents.*

GC-15 RIGHT OF ENTRY

The City reserves the right to enter the Site of the Work herein contracted for, by such agent or agents as they may elect, for the purpose of inspecting the Work, or for the purpose of installing such collateral Work as the City may desire. Contractor shall cooperate and coordinate with other contractors prosecuting other phases of the construction. Furthermore, if deemed necessary by the Engineer, Contractor will incorporate work activities of other City contractors directly into the schedule such that no phase of the Project(s) is delayed or impacted.

GC-16 NOTICES

Any notice, consent, approval, or other communication which is provided for or required by the Agreement Documents must be in writing and may be delivered in person to any party or may be sent by a facsimile transmission or by registered or certified U.S. mail, with postage prepaid, return receipt requested. Copies of all facsimiles shall also be sent via first class mail. Any such notice or other written communication shall be deemed received by the party to whom it is sent (i) in the case of delivery by hand or delivery by reputable national or local courier (such as United Parcel Service or Federal Express), on the date of delivery to the party to whom such notice is addressed, (ii) in the case of facsimile transmission, one working day after the date of successful transmission (provided that an additional first class mail copy of such notice is subsequently received within five (5) days of the facsimile transmission), and (iii) in the case of registered or certified mail, the date receipt is acknowledged on the return

receipt for such notice. All such notices and other written communications shall be sent to the persons and addresses listed below

If to Owner:

Contract Administrator
Department of Watershed Management
55 Trinity Avenue
Suite 5400
City Hall
Atlanta, Georgia 30303

and

Chief Procurement Officer
Department of Procurement
Room 1790
55 Trinity Avenue
Atlanta, Georgia 30303_____

If to Contractor:

Representative
Contractor
Address
City, State, Zip_____

The addresses and persons listed may be changed at any time by giving Written Notice in accordance with this Article GC-16.

GC-17 SAFETY PRECAUTIONS AND PROGRAMS

The City, the Engineer, or their agents, employees or representatives are not responsible for the means, methods, techniques, sequences or procedures utilized by Contractor, or for the safety precautions and programs in connection with the Work. Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work and for complying with all applicable rules, ordinances, state and federal laws and regulations.

GC-18 SAFETY OF PERSONS AND PROPERTY

GC-18.1 Damage, Injury, or Loss

Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury, or loss to:

- (1) All employees on the Work and all other persons who may be affected thereby;
- (2) All the Work and all Materials and Equipment to be incorporated therein, whether in storage on or off the site, under the care, custody, or control of Contractor or any of Contractor's Subcontractors;
- (3) Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction; and
- (4) The Work of the City or other separate contractors.

GC-18.2 Notice

Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations, and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury, or loss.

GC-18.3 Warning, Signage

Contractor shall erect and maintain, as required by existing conditions and the progress of the Work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

GC-18.4 Hazardous Materials

When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

GC-18.5 Remedy

Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by Contractor, any Subcontractor, Supplier or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, except damage or loss attributable solely to the acts or omissions of the City, the Engineer or anyone directly or indirectly employed by any of them in any way, or by anyone for whose acts any of them may be liable, and not attributable to the fault or negligence of Contractor. The foregoing obligations of Contractor are in addition to Contractor's obligations under the Insurance Section of the General Conditions or other provisions of the General Conditions.

GC-18.6 Project Safety Coordinator

Contractor shall provide a project safety coordinator who shall be devoted full time toward accident prevention during construction. The qualifications of the project safety coordinator shall be submitted to the Department of Watershed Management Office of Security and Safety (OSS) for approval. If the candidate meets the qualifications, the candidate will be interviewed by OSS to confirm the candidate's experience. Individuals must meet the requirements outlined below to be qualified for the position.

- (1) (a) Four (4) year Bachelor's degree and Five (5) years of construction loss control or construction safety experience; OR
(b) Ten (10) years of construction loss control or construction safety experience, AND
- (2) Current certifications as listed below in a, b, and c:
 - (a) OSHA 510 or equivalent 30 hours of construction safety training.
 - Trenching and Excavation (Standards- 29 CFR- 1926.651)
 - Confined Space Entry (Standards- 29 CFR- 1910.146 App. E), AND
 - (b) Traffic Control/flagging (Certified GDOT flagger), AND
 - (c) First Aide/CPR/AED (Standards- 29 CFR- 1910.266 (App. B)).

GC-18.7 Loads

Contractor shall not load or permit any part of the Work to be loaded so as to endanger its safety.

GC-18.8 Emergencies

In any emergency affecting the safety of persons or property, Contractor shall act, at Contractor's discretion, to prevent threatened damage, injury or loss. Any additional compensation or extension of time claimed by Contractor on account of emergency Work shall be determined as provided in the Agreement Documents, including GC-26 and GC-41.

GC-18.9 Miscellaneous

GC-18.9.1

Contractor acknowledges that it is fully aware of appropriate and safe procedures regarding blasting, including the contents and requirements of Official Code of Georgia Annotated § 25-9-1 through § 25-9-12, Blasting or Excavating Near Underground Gas Pipes and Facilities, any amendments thereto and rules and regulations issued pursuant thereto, and Contractor shall fully comply therewith. Contractor agrees and acknowledges that any failure on its part to adhere to appropriate procedures and said laws, rules and regulations shall not only be a violation of law but shall also be a breach of Agreement.

GC-18.9.2

Contractor acknowledges that it is fully aware of appropriate and safe procedures regarding high voltage lines, including the contents and requirements of Official Code of Georgia Annotated § 46-3-30 through § 46-3-39, Safeguards Against Contact with High Voltage Lines, any amendments thereto and rules and regulations issued pursuant thereto, and Contractor shall fully comply therewith. Contractor also confirms that representatives of Contractor have visited the site of the Work and have taken into consideration the location of all electric power lines on and adjacent to all areas onto which the Agreement Documents require or permit Contractor to Work, to store materials or to stage operations, and that

Contractor has obtained from the owner or owners of the aforesaid electric power lines advice in writing as to the amount of voltage carried by the aforesaid lines. Contractor agrees that any failure on its part to adhere to appropriate procedures and said laws, rules and regulations shall not only be a violation of the law but shall also be a breach of Agreement.

GC-18.9.3

Contractor acknowledges and agrees that he is the person responsible under the law and that he is the person employing or directing others to perform labor within the meaning of Official Code of Georgia Annotated § 34-1-1, Labor and Industrial Relations. He acknowledges and agrees likewise that he will comply with said law.

GC-18.9.4

Contractor shall protect all Work, including but not limited to, excavations and trenches, from rain water, surface water, and backup of drains and sewers. Contractor shall furnish all labor, pumps, shoring, enclosures, and Equipment necessary to protect and keep the Work free of water.

GC-18.9.5

The provisions, terms and conditions of this Section, although very specific, are in no way intended to limit the general requirements hereof or the applicability of laws relating to Work conditions, safety or accident prevention and no specific provision or combination of specific provisions in any of said subsections or in any other parts or sections of the Agreement Documents shall be deemed to limit the obligations or responsibility of Contractor contained in general provisions with respect thereto or in laws, statutes, acts, rules or regulations which are applicable thereto but which are not specifically referred to in any part of the Agreement Documents.

GC-19 USE OF PREMISES AND CLEAN UP

GC-19.1 Storage, Cleanup and Cutting

Contractor expressly undertakes at no additional cost to the City:

- (1) To store its Materials, Supplies and Equipment at the Site of the Work in such orderly fashion and in such locations as approved by the Engineer that will not unduly interfere with the progress of the Work, or the Work of any other contractors or the activities of City personnel.
- (2) To clean up all refuse, rubbish, scrap materials, and debris caused by its operations to the end that at all times the Site of the Work shall present a neat orderly and workmanlike appearance. No items shall be left or discarded elsewhere on the Site, or any other City sites. Items that are to be discarded shall be removed to approved dump areas.

- (3) To remove all surplus material, false work, temporary structures, including foundations thereof, temporary plants of any description and debris of every nature resulting from its operations, and to put the Site in a neat, orderly condition before final payment. Such final cleanup Work shall be performed within the time specified for completion of Work, with such exceptions as may be approved in writing by the City. Unless otherwise provided in the Specifications, Contractor shall clean any portion of Work for which a separate time for completion is specified and the Site thereof to the above standards within the specified time, with such exceptions as may be approved in writing by the City.
- (4) To effect all cutting, fitting or patching of its Work required to make the same to conform to the Plans and Specifications and except with the consent of the City, not to cut or otherwise alter the Work of any other contractor.

GC-19.2 Protection and Use of Site

Contractor shall, at no additional cost to the City:

- (1) Coordinate all of Contractor's operations with, and secure approval from, the City before using any portion of the Site. Contractor shall assume full responsibility for any damage to any such land or area, or to the City or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work.
- (2) Cause its agents and employees to park their vehicles only at locations directed by the City. Contractor's agents and employees shall clean vehicles leaving the Site so as not to muddy roads in the vicinity of the Site. Vehicles shall be brought to the Site only in connection with necessary Work on the Project. In no event shall vehicles be brought to the Site outside normal working hours unless the City gives specific written permission in advance.
- (3) In connection with Contractor's operations, provide for the free flow of traffic over roads or streets in or adjacent to the Site. Contractor shall keep roads and streets free from obstructions of any character that might present a hazard or interference with traffic and in such condition that traffic can be adequately accommodated. When operations in connection with the Work necessitates the closing of traffic lanes, Contractor shall arrange in advance with the City, any adjacent property owners affected, and appropriate local authorities for such closing and shall provide as necessary appropriate barricades, signs, markers, flares and other devices and flagmen as may be required by the Engineer or the local authorities for traffic guides and public safety.
- (4) Provide facilities for its use and only at locations approved or directed by the City. Unless otherwise specified in the Agreement Documents, Contractor shall provide all power and lighting necessary for its Work, complying in all cases with local and national electrical codes, OSHA regulations, and any other applicable laws. The City shall direct the point

or points to be used for service connection. Contractor shall provide telephone facilities for its own use and only at locations approved or directed by the City.

- (5) Unless otherwise specifically provided in the Agreement Documents, Contractor shall provide its own temporary facilities, including an office and a watertight, closed area for storage and protection of Materials and Equipment to be used for, or incorporated in, the Work, except as specifically agreed in the Agreement Documents. Contractor's shanties, material storage rooms, field offices and the like will be approved by the City and placed in locations designated by the City. If it becomes necessary during the course of the Work for Contractor to relocate its field operations, it will do so in an expeditious manner and at no additional cost.
- (6) Contractor shall take measures to control the blowing or spreading of dust, smoke, dirt, mud and refuse from its Work to avoid nuisance and inconvenience to others whether on or off the Site. These measures shall be in compliance with, without being limited to, all applicable laws, and shall be subject to the City's approval. Contractor shall furnish all necessary labor and Materials such as water, approved chemicals, and Equipment.
- (7) Contractor shall be responsible for the removal or drainage of all water interfering with the proper prosecution of its Work. It shall, at all times, assure such drainage and shall not be a nuisance or inconvenience to the City, other contractors or their Work, or the occupants or users of any other public or private area on or off the Site. This Article supplements, and does not supersede, any drainage or dewatering called for elsewhere in the Agreement Documents.
- (8) Contractor shall not use permanent installed systems or equipment without permission of the City. If such permission is granted prior to completion of the Work, Contractor shall restore all parts of the system or equipment used by replacing materials, traps, valves, filters, motors, lamps, and the like to the extent that the City considers them to have been damaged or if their usefulness has been impaired or diminished by their temporary use by Contractor.
- (9) No part of any surface shall be loaded during construction with more weight than it can safely bear at the time. Should damage occur through violation of this requirement by Contractor, it shall be solely liable for such damage and any consequence.
- (10) It shall be Contractor's responsibility to receive and unload its Materials and pay all charges therefor, including, without limitation, demurrage or charges for delays in loading. Contractor shall instruct vendors or Suppliers making such deliveries exactly where they shall go. Contractor shall constantly keep the City advised of its Material delivery schedule and shall update it as required by the City so that Materials will be available to complete the Work on time. Contractor shall schedule Material deliveries so as to interfere as little as possible with anyone else's Work on the Project but within the normal Work hours. Contractor shall require that

Materials and Equipment delivered shall be identified with Contractor's name, purchase order, and identification numbers. Contractor shall sign for all Materials delivered and shall be responsible for their safekeeping.

GC-20 PROTECTION OF AGREEMENT WORK

Contractor shall be responsible for:

- (1) Maintenance and protection of Work until final completion and acceptance, including, but not limited to, the storage of Materials and Equipment, erection of temporary structures and provisions for drainage as necessary to protect Work from injury, damage or loss;
- (2) Any injury, damage, or loss to Work resulting from the action of the elements or any other cause, irrespective of fault or negligence, excepting only such injury, damage, or loss as is caused solely by the negligence or willful misconduct of the City;
- (3) Protection of its Work and materials and the Work and materials of its Subcontractors or Suppliers from damage or injury from the weather; and
- (4) Exercising due care to avoid injury or damage to the Work of other contractors on site.

Any portion of Work suffering injury, damage, or loss for which Contractor is responsible under 1, 2, 3 or 4, above, will be considered defective and shall be corrected or replaced without additional cost to City.

GC-21 DEFECTS IN THE WORK AND UNAUTHORIZED WORK

Contractor shall promptly remove from the premises all Work rejected by the City for failure to comply with Agreement Documents, whether incorporated in the construction or not, and Contractor shall promptly replace and re-execute the Work in accordance with the Agreement Documents and without expense to City and shall bear the expense of making good all Work of other contractors destroyed or damaged by such removal, or replacement. All removal and replacement Work shall be done at Contractor's expense.

If Contractor defaults or neglects to carry out all or any part of the Work in accordance with the Agreement Documents, and fails within three (3) working days after receipt of Written Notice from the City to commence and continue correction and cure of such default, noncompliance, or neglect with diligence and promptness, the City may, after twenty-four (24) hours following receipt by Contractor of an additional Written Notice and without prejudice to any other remedy the City may have, make good such deficiencies and may further elect to perform and to complete all or any part of Work thereafter through such means as the City may select, including the use of a new or supplemental contractor. In such case an appropriate Change Order shall be issued deducting from the payments then or thereafter due Contractor, the cost of correcting such deficiencies. If the payments then or thereafter due Contractor are not sufficient to cover such amount, Contractor shall pay the difference to the City on demand.

Minor, inconsequential defects may be waived in writing by the City, but the City's failure or refusal to exercise such authority shall not be subject to claim by Contractor. If a waiver (whether minor or major, consequential or inconsequential) will result in an appreciable saving of costs to Contractor, including costs of Work in place and savings when compared to potential costs of rejection and replacement under this clause, it will be made only upon an equivalent adjustment in compensation.

GC-22 GUARANTEE OF WORK AND MATERIALS

GC-22.1 Warranty of Materials, Equipment and Work

Contractor warrants to the City and the Engineer that all Materials and Equipment furnished under this Agreement will be new and of workmanlike quality unless otherwise specified, and that all Work will be of good quality, free from faults and defects and in conformance with the Agreement Documents. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Engineer, Contractor shall furnish satisfactory evidence as to the kind and quality of Materials and Equipment. This warranty is not limited by any other provision of the Agreement Documents. The Warranties set forth in this Article and elsewhere in the Agreement Documents shall survive final acceptance of the Work. All warranties are in addition to the rights, remedies, and redress that the City has at law or in equity, and none of Contractor's warranties shall be deemed a sole or exclusive remedy to the City.

GC-22.2 Warranty of Continued Liability of Electronics

Contractor shall warrant to Owner that all goods or equipment which Contractor is required to purchase under the Agreement and which contain embedded codes, chips, microprocessors, microcontrollers, clock circuits (including integrated circuits), computer operating systems, computer software, custom application programming, or other similar systems/technologies that calculate date or time data shall correctly and without failure, malfunction, or need for operator intervention, display, calculate, compute, and process date or time data before, during, and beyond any changes in the date, including leap year, and including changes at year end, decade end, and century end, as needed.

GC-22.3 Guarantee and Repair

If within one (1) year after the Date of Final Completion and Final Acceptance of the Work by the City, or within such longer period of time as may be prescribed by law or by the term of any applicable special warranty required by the Contract Documents, any of the Work is found to be defective or not in accordance with the Agreement Documents, Contractor shall correct it promptly after receipt of a Written Notice from the City to do so. This obligation shall survive both final payment for the Work or designated portion thereof and termination of the Agreement. The City shall give such notice promptly after discovery of the condition. Contractor acknowledges that this one (1) year period provides a period during which Contractor has a duty to repair and does not in any way limit Contractor's liability for Work that is not in accordance with the Agreement

Documents, including any that may be discovered more than one (1) year after the Date of Final Completion and Final Acceptance.

GC-22.4 Manufacturer Warranties

Without limiting the responsibility or liability of Contractor under the Agreement, all warranties given by manufacturers on Materials or Equipment incorporated in the Work are hereby assigned by Contractor to the City at no additional cost to the City. If requested, Contractor shall execute enforceable formal assignments of said manufacturer's warranties to the City at no additional cost to the City. Contractor shall not obtain any Materials or Equipment under warranties, which do not run directly to the benefit of the City, and all such warranties shall be directly enforceable by the City, but Contractor understands and agrees that it is jointly and severally liable with the manufacturers for any warranties provided.

GC-22.5 Non-Exclusive Nature of Warranties

The foregoing warranties, and those contained elsewhere in the Agreement Documents or implied by law, shall be deemed cumulative and not alternative or exclusive. No one or more of them shall be deemed to alter or limit any other.

GC-23 TERMINATION OF AGREEMENT

GC-23.1 Termination for Contractor Default

If Contractor becomes insolvent, or makes a general assignment for the benefit of creditors, or if a receiver is appointed on account of Contractor's insolvency, or if Contractor refuses or fails, except in cases for which extension of time is provided, to supply enough properly skilled workers or proper Materials, or fails to make prompt payment to Subcontractors or for Materials or labor, or disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, or otherwise is guilty of a material violation of a provision of the Agreement Documents so as to be in material breach and default of the Agreement, then City may terminate the Agreement for default, either in whole or in part, without prejudice to any other right or remedy the City may have after giving Contractor and its surety seven (7) days to cure the default. For purposes of this Article, a material violation shall include, without limitation, any violation of or failure to comply with any obligation of the Agreement which the City, in its sole discretion, determines is likely to result in any damage to the City, the Work, or any public or private interest.

If the surety and/or Contractor does not cure the default within seven (7) days from the date of the mailing to Contractor and the surety of notice of default, City may, without further notice, terminate for default and may take over Work and prosecute the same to completion by contract or by Force Account or by whatever means it deems appropriate for the account and the expense of Contractor and Contractor and its surety shall be liable to City for any excess cost incurred thereby, and in such event City may take possession of and utilize in completing Work, such materials, appliances, and plant as

may be on the Site of Work and necessary therefore. Upon such termination Contractor shall:

- (1) Preserve all Materials, Drawings and records and Plans at Site of the Work until notified in writing of those items that will be used in completing Work.
- (2) Remove from Site of the Work all construction materials, equipment and plant not designated for use in such notice.
- (3) Assist the City in making an inventory of all Materials and Equipment in storage at the Site of Work, in route to the Site of Work, in storage or manufactured at other locations, and on order from Suppliers.

The City shall further have the right to declare a default without terminating the Agreement for default in whole or in part. In such event, the City shall have the right, at its sole discretion, to supplement Contractor's forces if the City so chooses and deduct the cost of same from the amounts otherwise due Contractor. The City's failure to declare a default or terminate the Agreement in whole or in part shall not determine whether Contractor is, in fact, in material breach of the Agreement because the City shall also have the option to allow Contractor's defective performance to continue and collect such damages as the City may incur from Contractor and its surety.

In the event that the City incurs costs or expenses in performing or completing any portion of Contractor's scope of Work, the City's actual damages shall, at the City's discretion, include a fee up to 15% of such actual costs for performing such work. Such fee shall be computed on the actual costs incurred by the City for labor, materials, equipment, services, administrative and personnel costs and additional design and professional consulting fees, incurred as a result of Contractor's default.

Contractor acknowledges and agrees that an appropriate termination for default is adequate grounds for Contractor's disqualification from future City contracts. This provision shall survive the expiration or termination of this Agreement and any amendments to this Agreement.

In the event any termination for default is found to be wrongful or improper, Contractor agrees that its sole and exclusive remedy is to have the termination treated as a termination for convenience in accordance with the provisions of this Agreement.

GC-23.2 City's Right to Stop the Work

If Contractor fails to correct defective Work as required by the Agreement Documents, or fails to carry out the Work or supply labor or Materials in accordance with the Agreement Documents, or otherwise fails to meet or satisfactorily complete any of its obligations under this Agreement, the City, in writing, may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the City and the Engineer to stop the Work shall not give rise to any duty on the part of the City to exercise this right for the benefit of Contractor or any

other person or entity. Contractor shall not be entitled to any extension of time or for compensation of any sort in the event that the City stops work pursuant to this provision.

GC-23.3 Intentionally Omitted

GC-23.4 Termination for Convenience of City

GC-23.4.1

The City may, at any time upon ten (10) days Written Notice to Contractor, terminate (without prejudice to any right or remedy of the City) the whole or any portion of the Work for the convenience of the City.

GC-23.4.2

If, after Contractor has been terminated for default, it is determined that Contractor was not in default or that the termination for default was improper for any reason, then such termination shall be considered a termination for convenience.

GC-23.4.3

If the City terminates the whole or any portion of the Work for convenience, then the City shall only be liable to Contractor for those costs reimbursable to Contractor in accordance with Article 23.4.4; provided, however, that if it reasonably appears to the City that Contractor would have sustained a loss on the entire Agreement had it been completed, no profit shall be included or allowed hereunder and an appropriate adjustment shall be made reducing the amount of settlement so that Contractor's loss on the portion of the Agreement it did perform is proportioned, from a percentage completion basis, to the loss Contractor would have sustained on the entire Agreement. In no event shall Contractor be entitled to anticipated profit on work not performed. Contractor shall, however, be entitled to any profit earned on the work performed to date, but Contractor acknowledges (1) that unit rates may be subject to adjustment, either upward or downward, based upon the variation in estimated quantity provisions of this Agreement, and (2) if the City determines that Contractor's schedule of values was materially unbalanced (or "front-end loaded"), payments previously made to Contractor shall be refunded to the City or withheld from amounts otherwise due Contractor. The intent of this Article is to avoid any Contractor windfall at the City's expense while at the same time preserving the benefit of the bargain, either positive or negative, for Contractor.

GC-23.4.4

If the City terminates the whole or any portion of the Work for convenience, the City shall pay Contractor the amounts determined by the Engineer as follows:

- (1) To the extent not previously paid for, Contractor shall be paid on a percentage completion basis in accordance with any approved schedule

- of values for the value of the work completed to date, including items such as mobilization and general conditions costs (based on percent complete).
- (2) To the extent not previously paid for and to the extent that the Agreement Documents call for payment on the basis of unit rates, Contractor shall be paid for all work actually performed at the unit rate established in the Agreement Documents, with such adjustment, if any, as may be required either upward or downward by the variation in estimated quantity provisions applicable to unit rates under the Agreement.
 - (3) The reasonable costs of settlement, including accounting, clerical, and other expenses reasonably necessary for the preparation of settlement claims and supporting data with respect to the terminated portion of the Agreement and for the termination and settlement of subcontracts thereunder, together with reasonable storage, transportation, and other costs incurred in connection with the protection or disposition of property allocable to this Agreement. This amount shall not include any attorneys' fees or other legal costs or claim preparation costs or expert or consulting fees and Contractor shall not be entitled to recovery or compensation of any such costs or fees under any circumstances.

GC-23.4.5

Contractor shall specifically require its Subcontractors and suppliers and those with whom they contract to agree to the provisions of this Article governing termination for convenience. In no event shall the City be responsible for anticipated profit on work not performed or "restocking charges." The City's potential liability for convenience termination costs shall be based on work actually performed and costs actually incurred, provided that the termination shall not in any event transform a Contractor or Subcontractor's probable net loss position into a profitable or "cost plus" recovery.

GC-23.5 General Termination Provisions

GC-23.5.1

If the City terminates the whole or any part of the Work for default, then the City may procure, upon such terms and in such manner as the City may deem appropriate, supplies or services similar to those so terminated, and Contractor shall be liable to the City for any excess costs for such similar supplies or services. Contractor shall continue the performance of this Agreement to the extent not terminated hereunder.

GC-23.5.2

In the event of a Contractor default under any of the provisions of the Agreement, after written notice and a failure to cure within seven (7) days of that notice, Contractor and its surety shall be responsible to pay to the City such reasonable attorneys' fees as the City may expend as a result of the default, including all costs, expenses and filing fees incidental thereto, including, without limitation, expert fees, consultants' fees, arbitrator fees (if any), and prejudgment interest at

the commercial account rate on all sums due, whether liquidated or unliquidated. Any judgment or arbitration award entered in favor of the City against Contractor or its surety shall bear interest from the time of entry of the judgment or the date of the arbitration award at the commercial account rate.

GC-23.5.3

After receipt of a notice of termination from the City, whether for default or for convenience, and except as otherwise directed by the City, Contractor shall:

- (1) Stop Work under the Agreement on the date and to the extent specified in the notice of termination;
- (2) Place no further orders or subcontracts for Materials, services, or facilities, except as may be necessary for completion of such portion of the Work under the Agreement as is not terminated;
- (3) Terminate all orders and subcontracts to the extent that they relate to the performance of Work terminated by the notice of termination and are not assigned as set forth below;
- (4) If so requested by the City, assign to the City in the manner, at the times and to the extent directed by the City, all of the rights, title, and interest of Contractor under the orders and subcontracts so selected and requested for assignment;
- (5) Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of the City to the extent the Engineer may require, in accordance with the provisions of this Agreement;
- (6) Transfer title and deliver to the entity or entities designated by the City, in the manner, at the times and to the extent, if any, directed by the City, and to the extent specifically produced or specifically acquired by Contractor for the performance of such portion of the Work as has been terminated:
 - (a) The fabricated or unfabricated parts, Work in progress, partially completed supplies, and Equipment, Materials, parts, tools, dies, jigs, and other fixtures, completed Work, supplies and other material produced as part of, or acquired in connection with the performance of the Work terminated by the notice of termination; and
 - (b) The completed or partially completed Plans, Drawings, information, and other property related to the Work, including as-built information;
- (7) If so requested by the City, use best efforts to sell for the benefit of the City, in the manner, at the times, to the extent, and at the price or prices directed or authorized by the City, any property of the types referred to in Article GC-23.5.3(6); provided, however, that Contractor:
 - (a) Shall not be required to extend credit to any buyer; and
 - (b) May re-acquire any such property under the conditions prescribed by and at a price or prices approved by the City; and, provided, further that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the City to

Contractor under this Agreement or shall otherwise be credited to the price or cost of the Work covered by this Agreement or paid in such other manner as the City may direct;

- (8) Complete performance of such part of the Work as shall not have been terminated by the notice of termination; and
- (9) Take such action as may be necessary, or as the City may direct, for the protection and preservation of the property related to the Agreement, which is in the possession of Contractor and in which the City has or may acquire an interest.

GC-23.5.4

Contractor shall preserve and make available to the City, at all reasonable times at the office of Contractor, but without direct charge to the City, all its books, records, documents and other evidence bearing on the costs and expenses of Contractor and any Subcontractor or Supplier under the Agreement, and any photographs, microphotographs, or other authentic reproductions thereof and Owner shall have the right at any time to audit the same.

GC-23.5.5

In arriving at any amount due Contractor for any termination for default or convenience, there shall be deducted:

- (1) All unliquidated advance or other payments on account theretofore made to Contractor applicable to the termination portion of this Agreement;
- (2) Any claim which the City may have against Contractor;
- (3) Such claim as the Engineer determines to be necessary to protect the City against loss because of outstanding or potential claims of any type or nature; and
- (4) The agreed price for, or the proceeds of sale of, any Materials, supplies, or other things acquired by Contractor or sold, pursuant to the provisions of Article GC-23.5.3(7) and not otherwise recovered by or credited to the City.

GC-23.5.6

Contractor shall refund to the City any amounts paid by the City to Contractor in excess of Contractor's entitlement specified hereunder.

GC-23.5.7

The City may, at its option, have costs audited and certified by independent certified public accountants selected by the City.

GC-23.5.8

Contractor shall be entitled to only those damages and that relief from termination by the City as specifically provided hereunder.

GC-24 SUSPENSION OF WORK

GC-24.1 Right to Suspend Work

The City may order Contractor, in writing, to suspend, delay, or interrupt all or any part of the Work for such period of time as the City may determine to be appropriate for the convenience of the City.

GC-24.2 Rights Upon Certain Unreasonable Suspensions

If the performance of the Work is, for an unreasonable period of time, suspended, delayed, or interrupted by an act of the City or Engineer in the administration of the Agreement, or by failure of any one of them to act within the time specified in the Agreement (or if no time is specified, within a reasonable time), or by any act of either of them which is attributable to their fault or neglect, adjustment shall be made in the Agreement Time only for any extension in the time required for performance of the Work necessarily caused by such unreasonable suspension, delay, or interruption and the Agreement modified in writing accordingly. However, no adjustment shall be made under this Article for any suspension, delay, or interruption for which an adjustment is provided or excluded under any other provision of the Agreement Documents, and no adjustment shall be made to the extent that performance would have been so suspended, delayed or interrupted by any other cause, including the fault or negligence of Contractor or excusable delays that are unforeseeable and not attributable to the fault or neglect of the City or Contractor and beyond the control of each of them. No claim for a time adjustment under this Article shall be allowed unless it is presented in accordance with the provisions of the Agreement governing Claims and compliance with the claims provision shall be a condition precedent to the right to a time adjustment.

GC-24.3 Damages Upon Suspension

Nothing contained in this Article authorizes the recovery of delay or impact damages, except as expressly authorized in this Agreement; and compliance by Contractor with the claims provision shall be a condition precedent to the right to any Contract adjustment on account of a suspension of the Work. Contractor expressly agrees that it shall not be entitled to any increase in the Agreement Price or to any monetary damages on account of a suspension, delay, interruption, interference or impact, unless the notice, documentation, and pricing requirements of this Agreement have been met.

GC-24.4 Time Extension Upon Suspension

Under the terms of this Agreement, in order for Contractor to receive extensions of time for excusable delays, the delays must (i) be on the critical path, (ii) be beyond the

reasonable control of Contractor and those for whom it is responsible including its Subcontractors and Suppliers and others working by or through them, (iii) not be attributable to any factor for which Contractor has assumed the risk of performance (such as labor availability), (iv) not be attributable in whole or in part to Contractor's fault or neglect or the fault or neglect of those for whom Contractor is responsible, including Subcontractors and Suppliers and others working by or through them, and (v) not be concurrent with non-excusable delays that are on the critical path. If Contractor meets these five (5) requirements, then Contractor's sole remedy for such delay shall be an extension of the Agreement Time for the period of time during which all five (5) elements continue to be met, which shall be implemented by Change Order; provided, however, Contractor shall not be entitled to any extension of the Agreement Time (i) if Contractor fails to comply with notice requirements in the Contract, (ii) if such delays do not cause Contractor to achieve Substantial Completion of the entire Work later than the then current Substantial Completion Date, or (iii) if Contractor fails to work around such delay where such work around was available to Contractor. In all events, Contractor must comply with the notice and claim provisions set forth in this and other provisions of the Agreement in order to be entitled to any extension of the Agreement Time.

GC-24.5 Damages for Non-Excusable Delays

Under the terms of this Agreement, liquidated or actual damages (as specified in the Agreement and as appropriate) shall be assessed for all non-excusable delays. Unless and until Contractor satisfies its obligations under and satisfies all criteria set forth in GC-24.4, delays shall be deemed non-excusable. The burden of proof shall be upon Contractor to establish that delays and untimely completion are attributable to excusable delays.

GC-24.6 Abnormal Weather

Abnormal weather may constitute an excusable delay if other requirements for excusable delays are met (for example, weather-sensitive work must be on the critical path.) The Agreement Time will not, however, be extended due to normal inclement weather. Unless Contractor can substantiate that there was greater than normal inclement weather using a ten (10) year average of accumulated record mean values from climatological data compiled by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration for Atlanta, Georgia, and that such alleged greater than normal inclement weather qualifies as excusable delay as set forth above, Contractor shall not be entitled to an extension of time. In no event will "dry-out" delay days be allowed. Any time extension shall be based on the number of additional days of adverse weather and not upon the time required to recover from said weather.

GC-24.7 Impacts From Adjacent Property

Contractor acknowledges and agrees that it will be interacting with numerous citizens and residents of the City and will be working in close proximity to their homes, businesses, and private property. Contractor warrants that it has made due allowance for dealing with the concerns and complaints of these citizens and residents and any delays, interruptions, interferences, disruptions, or other impacts resulting therefrom.

Contractor further warrants and agrees that it will fully cooperate with the City to minimize the adverse affects of the Project on the City's residents by resequencing work or adjusting its means, methods, techniques, and procedures to minimize and mitigate the effect upon the City's residents and that the cost of these mitigation efforts has been included in Contractor's price to the City.

GC-25 COMMENCEMENT AND PROSECUTION OF THE WORK

Contractor shall, within ten (10) days after receipt from the City of a written Notice to Proceed, commence Work to be done under this Agreement. Contractor shall diligently prosecute Work and all portions thereof to completion within the times specified therefor. The capacity of Contractor's construction and manufacturing equipment and plans, sequence and methods of operations, and forces employed, including management and supervisory personnel, shall be such as to ensure completion of Work within the specified time.

It is expressly understood and agreed by and between Contractor and City that Agreement Time for the completion of Work described herein is a reasonable time, taking into consideration the unique requirements of the Work (including performance of the Work in close proximity to the private property of the citizens and residents of the City), the average climate and economic conditions in the area, and other factors prevailing in the locality of the Work (such as, without limitation, the availability of labor, equipment and materials).

GC-26 TIME

GC-26.1 Progress and Completion

GC-26.1.1

All time limits stated in the Agreement Documents are of the essence of the Agreement.

GC-26.1.2

Contractor shall begin the Work within ten (10) days after the issuance of written Notice to Proceed. Contractor shall carry the Work forward expeditiously with adequate forces and shall achieve Substantial Completion of the Work and Final Completion within the times stated in the Agreement Documents.

GC-26.2 Delay, Damages, and Extensions of Time

GC-26.2.1

Contractor shall not be entitled to payment or compensation of any kind from the City for direct, indirect, impact, or delay damages, including but not limited to costs of delay, disruption, interference, impact or hindrance from any cause whatsoever, whether such delay, disruption, interference, impact or hindrance be

reasonable or unreasonable, foreseeable or unforeseeable, or avoidable or unavoidable, except as expressly provided in this Agreement.

In any and all events, the City's liability for damages for delay, disruption, interference, impact or hindrance shall be limited to the following actual direct job site related costs that are solely incurred as a function of time: (1) costs of job site supervision, (2) direct cost of general conditions items, including job site office expenses for trailer rental, telephone, electricity, heat, and water, (3) except for tunnel boring machines which shall be governed by the terms of GC-41.6, equipment expenses at the Force Account rates specified in the provisions of this Agreement governing changes; and (4) a markup for profit and overhead on actual direct costs, in accordance with the Force Account rates specified in the provisions of this Agreement governing changes.

GC-26.2.2

The Agreement Time shall be adjusted only for excusable delays. In the event Contractor requests an extension of the Agreement Time, it shall furnish such justification and supporting evidence as the City may deem necessary for a determination as to whether Contractor is entitled to an extension of time under the provisions of the Agreement. The City, after receipt of such justification and supporting evidence, shall make a decision thereon and shall advise Contractor in writing thereof. If the City finds that Contractor is entitled to any extension of the Agreement Time, the City's determination as to the total number of days' extension shall be based upon the current CPM and on all data relevant to the extension as described in the Agreement Documents. Contractor acknowledges and agrees that delays in activities that according to the approved and current CPM Schedule do not affect the critical path do not have any effect upon the Agreement Time and therefore will not be the basis for a change thereof.

GC-26.2.3 [Intentionally Omitted]

GC-26.2.4 [Intentionally Omitted]

GC-26.2.5 [Intentionally Omitted]

GC-26.2.6 [Intentionally Omitted]

GC-26.2.7

In order for Contractor to be entitled to any extension of the Agreement Time, Contractor must comply with the Claim provisions of GC-41 and GC-26. Such statement of the claim, in addition to complying with all other provisions of the Agreement relating to Claims and delays, must provide all information required

by the scheduling requirements of the Agreement Documents and further provide the following specific information:

- (1) Nature of the delay;
- (2) Date (or anticipated date) of commencement of delay;
- (3) Activities on the approved current CPM Schedule affected by the delay, and/or new activities created by the delay and their relationship with existing activities;
- (4) Identification of person(s) or organization(s) or event(s) responsible for the delay;
- (5) Anticipated extent of delay; and
- (6) Recommended action to avoid or minimize the delay.

GC-26.2.8

The City shall receive and process such claims for extensions of time in accordance with the procedures set forth in Article GC-41, except that any Change Order issued shall only amend the time for completion.

GC-26.2.9

The failure of Contractor to file any claims for extension of time within the time limits prescribed and in the form and manner required shall be deemed a material prejudice to the interests of the City in canceling and mitigating such impacts, and shall constitute an absolute waiver of the claim and the right to file or thereafter prosecute the same. The purpose of the time limits, notice and form and manner requirements are, in part, to eliminate disputes over the existence, scope, and nature of events giving rise to claims, and the failure to abide by same will result in material prejudices to the City, even if the City were otherwise on notice of facts giving rise to the claim because, in part of the impact to the City's ability to document, dispute, or resolve issues as they arise, and also because of the impact to the City's efforts to entirely avoid disputes over claims not asserted in accordance with the Agreement Documents.

GC-26.2.10

If no schedule or agreement is made stating the date upon which written interpretations as set forth in the Agreement Documents shall be furnished, then no claim for delay shall be allowed on account of failure to furnish such interpretations until fifteen (15) days after demand is made for them, and not then unless such claim is reasonable.

GC-27 RESPONSIBILITY FOR COMPLETION

GC-27.1 Duty to Accelerate

Subject to the other provisions of the Agreement Documents, Contractor shall furnish such manpower, Materials, facilities, and Equipment and shall work such hours, including night shifts, overtime operations and Sundays and holidays, as may be necessary to ensure the prosecution and completion of the Work in accordance with the approved and currently-updated CPM Schedule. If Work actually in place falls behind the currently updated and approved CPM Schedule, and it becomes apparent from the current approved CPM Schedule that the Work will not be completed within the Agreement Time, Contractor agrees that it will, as necessary or as directed by the City, take some or all of the following actions at no additional cost to the City to improve its progress:

- (1) Increase manpower in such quantities and crafts as will eliminate, in the judgment of the City, the delay and backlog of Work;
- (2) Increase the number of working hours per shift, shifts per working day, working days per week, the amount of equipment or any combination of the foregoing, sufficiently to eliminate in the judgment of the City, the delay and backlog of Work;
- (3) Reschedule activities as necessary to eliminate in the judgment of the City the delay and backlog of Work; and
- (4) Any other measure required by the schedule requirements of the Special Conditions.

In addition, the City may require Contractor to submit a proposed revised CPM Schedule Recovery Plan demonstrating its program and proposed plan to make up lag in scheduled progress and to ensure completion of the Work within the Agreement Time. If the City finds the proposed plan not acceptable, the City may require Contractor to submit a new and/or revised plan with direction and other input from the City and Engineer.

GC-27.2 Recoverable Acceleration Expenses

In the limited and exclusive event that (1) the City directs Contractor to accelerate, and (2) it is subsequently determined that Contractor was entitled to time extensions for excusable delays which the City failed or refused to grant, and (3) Contractor in fact succeeds in accelerating substantial completion of the Project by substantially completing the Project significantly and materially sooner than what would have been the case had the City granted all time extensions to which Contractor was entitled, then, and only then, Contractor may be entitled to recoverable acceleration expenses as defined below if Contractor properly and timely complies with the provisions related to time, notice and form and substance of claims of the Agreement (including, without limitation, Articles GC-24, GC-26, and GC-41) Recoverable acceleration expenses shall be limited to the following without any markup for overhead and profit:

- (1) the premium portion only of overtime costs for hours worked in a single week that exceed 40 hours per week
- (2) if the overtime continues for more than 65% of the skilled labor on the site (including subcontractor personnel) for a continuous period of 8 weeks or

more, then beginning in the 9th week, a multiplier of 10% of the premium portion of the overtime costs may be added as recoverable acceleration expenses to cover the cost of any loss or damage or additional expense resulting from the acceleration.

No expenses other than the two items noted above shall be allowed as recoverable acceleration expenses. No claims for acceleration for work that is not on the critical path shall be permitted.

GC-27.3 Acceleration by City's Forces

Failure of Contractor to substantially comply with the requirements of Article GC-27.1 may be considered grounds for a determination by the City and/or the Engineer that Contractor is failing to prosecute the Work with such diligence as will ensure its completion within the time specified. In such case, upon forty-eight (48) hours prior Written Notice to Contractor, City shall have the right to furnish such additional labor and Materials as may be required to comply with the schedule, and Contractor shall be liable for such costs incurred by City as provided elsewhere in this Agreement.

GC-27.4 Set-Off of Acceleration Costs

Any monies due to the City under this Article may be set-off by the City against monies due from the City to Contractor.

GC-27.5 Acceleration Remedies Cumulative

The remedies of the City set out in this Section are in addition to, and without prejudice to, all other rights and remedies of the City including those stated elsewhere in the Agreement Documents. The remedies of Contractor, however, are sole and exclusive and contingent upon compliance with the Agreement provisions as to time, notice, form, and substance of Claims, including, without limitation, Articles GC-24, GC-26, and GC-41.

GC-28 WORKING DRAWINGS, SHOP DRAWINGS, DATA ON MATERIAL AND EQUIPMENT, SAMPLES, AND LICENSES

GC-28.1 General

GC-28.1.1

Contractor shall submit to the Engineer for review and exception, if any, such working Drawings, Shop Drawings, test reports and data on Materials, licenses, and Equipment (hereinafter in this article called data), and material samples (hereinafter in this article called samples) as are required for the proper control of Work, including but not limited to, those working Drawings, Shop Drawings, data and samples specifically required elsewhere in the Specifications and Agreement Documents. Submittals are required for any product that becomes a part of, or affects, the permanent Work.

GC-28.1.2

Data on Materials and Equipment include, without limitation, Materials and Equipment lists, catalog data sheets, cuts, diagrams and similar descriptive material. Materials and Equipment lists shall give, for each item thereon, the name and location of the Supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data.

GC-28.1.3

It is the duty of Contractor to check all Drawings, data and samples prepared by or for it before submitting them for review. Drawings and schedules shall also be checked and coordinated with the Work of all trades involved. Drawings and other submittals originating from Subcontractors will be reviewed and checked similarly by Contractor. Pursuant to this required review, Contractor shall indicate its approval, before they are submitted for review by the City, by affixing its stamp of approval, properly initialed and dated. All submittals shall be referenced to the applicable item, section or division of the Specifications.

GC-28.1.4

The Engineer's review of Drawings, data and samples submitted by Contractor will cover only general conformity to the Specifications, external connections, and dimensions which affect the installation. The Engineer's review and exception, if any, will not constitute an approval of dimensions, quantities, and details of the Material, Equipment, device, or item shown.

GC-28.1.5

Contractor shall not begin any of the Work covered by a Drawing, data, or a sample returned for correction until a revision or correction thereof has been reviewed and returned to it.

GC-28.1.6

The CPM Schedule shall include respective dates for the submission of shop and work Drawings, the beginning of manufacture, testing, and installation of Materials, Supplies, and Equipment.

GC-28.1.7

Acceptable submittals will be marked "No Exceptions Taken." Submittals requiring minor corrections before the Material or Equipment is acceptable will be marked "Make Corrections Noted." Contractor may order, fabricate, or ship the items included in the submittal, provided the indicated corrections are made. Drawings must be resubmitted for review prior to installation of Equipment or use of Materials, unless otherwise directed in writing by the Engineer.

GC-28.1.8

Submittals marked "Amend and Resubmit" must be revised to reflect required changes, and the initial review procedure repeated.

GC-28.1.9

The "Rejected - See Remarks" notation is used to indicate Materials or Equipment that are not acceptable. Upon return of a submittal so marked, Contractor shall repeat the initial review procedure utilizing acceptable Materials or Equipment.

GC-28.1.10

Drawings on other submittals not bearing the Engineer's "No Exceptions Taken" notation shall not be issued to Subcontractors or utilized for construction purposes. No Work shall be done or equipment installed without a drawing or submittal bearing the "No Exceptions Taken" notation. Contractor shall maintain at the job site a complete set of Drawings and other submittals bearing the Engineer's stamp.

GC-28.1.11

In the event Contractor obtains the City's approval for the use of equipment other than that which is called for in the Agreement Documents, Contractor shall, at its own expense and using methods approved by the City, make any changes to structures, piping and electrical work that may be necessary to accommodate this equipment. If Contractor substitutes any specified item of Material or Equipment with another item of Contractor's choosing as an "or equal" item, Contractor warrants the accuracy and adequacy of the design and performance of the substituted item and further warrants that it has exercised due diligence to ensure that the substituted item will function properly as a component into the integrated Project of which it is a part.

GC-28.1.12

Contractor shall submit all Drawings and schedules sufficiently in advance of construction requirements to provide no less than thirty (30) calendar days for checking and appropriate action.

GC-28.1.13

The review of Drawings and schedules will be general, but approval shall not be construed: (a) as permitting any departure from the Agreement requirements; (b) as relieving Contractor of responsibility for any errors, including details, dimensions, and Materials; and (c) as approving departures from details furnished by the City, except as otherwise provided herein.

GC-28.2 Shop Drawings

GC-28.2.1

When used in the Agreement Documents, the term "Shop Drawings" shall be considered to mean fabrication drawings, wiring and control diagrams, cuts, or entire catalogs, pamphlets, descriptive literature, and performance and test data. The Drawings shall be submitted using standard transmittal forms in accordance with detailed instructions furnished by the City. A separate transmittal sheet shall be used for reference to each item, section or division of the Specifications.

GC-28.2.2

Contractor shall submit six (6) sets of each Shop Drawing for review. On electrical and instrumentation and control submittals Contractor shall submit seven (7) copies of each for review.

GC-28.2.3

Each Shop Drawing shall include the following:

- (1) Number and title of the submittal;
- (2) Date of Drawing or revision;
- (3) Name of Project;
- (4) Name of Contractor and/or Subcontractor submitting Drawing and with its seal of approval;
- (5) Specification title and number; and
- (6) Clear identification of contents and location of the Work.

GC-28.2.4

Drawings for Work on utility facilities, streets and other facilities, which are constructed for owners other than the City, shall be coordinated so that information required by these owners is included on the Shop Drawings for their facilities.

GC-28.2.5

If Drawings show variations from Agreement requirements, Contractor shall describe such variations in its letter of transmittal. If acceptable, proper adjustment in the Agreement shall be implemented where appropriate. If Contractor fails to describe such variations, it shall not be relieved of the responsibility for executing the Work in accordance with Agreement, even though such Drawings have been reviewed.

GC-28.2.6

If the Drawings or schedules as submitted describe variations and show a departure from the Agreement requirements which the City finds to be in the interest of the City and to be so minor as not to involve a change in Agreement Price or Time, the City may return the reviewed Drawings without noting an exception.

GC-28.2.7

If no exceptions are taken by the City, each of the Shop Drawings will be identified by being so stamped and dated. Shop Drawings stamped "Rejected - See Remarks" and with required corrections shown, will be returned to Contractor for correction and re-submittal. On re-submittals, Contractor shall direct specific attention, in writing or on resubmitted Drawings, to revisions other than the corrections requested by the City on previous submissions. Contractor shall make any corrections required by the City. If Contractor considers any correction indicated on the drawings to constitute a change to the Agreement Drawings or Specifications, Contractor shall give Written Notice thereof to the City in accordance with GC-41. At least two (2) copies of Drawings or data submittals will be returned to Contractor.

GC-28.2.8

When the Drawings or data submittals have been completed to the satisfaction of the City, Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the City.

GC-28.2.9

After final review in which there are no exceptions noted or referenced, and before final payment is made, Contractor shall furnish to the City two (2) sets of record Shop Drawings, all clearly revised and completed and brought up to date, showing the permanent construction as actually made and marked FINAL/AS-BUILTS. One (1) set of such Shop Drawings shall be either drawn in ink on tracing cloth, or reproduced on mylar from which clear prints can be made. The other set could be a complete paper print.

GC-28.2.10

Contractor shall be responsible for and bear all cost of damages which may result from the ordering of any Material or from proceeding with any part of Work prior to the review, without exception, by the City of the necessary Shop Drawings.

GC-28.3 Working Drawings

GC-28.3.1

When used in the Agreement Documents, the term "Working Drawings" shall be considered to mean Contractor's plans, including a detailed narrative, for temporary structures such as temporary bulkheads, support of open cut excavation, support of utilities, ground water control systems, forming and false work; for underpinning; and for such other work as may be required for construction but does not become an integral part of the Project.

GC-28.3.2

Copies of Working Drawings shall be submitted to the City where required by the Agreement Documents or requested by the City and shall be submitted at least thirty (30) calendar days in advance of their being required for Work.

GC-28.3.3

Working Drawings shall be signed and sealed by an engineer licensed to practice in the State of Georgia and shall convey, or be accompanied by, calculation of other sufficient information to completely explain the structure, machine, or system described and its intended manner of use. Prior to commencing such Work, Working Drawings must have been reviewed to the satisfaction of the City, and each Working Drawing identified by the City with the Engineer's stamp of "No Exception Taken." Review of the Working Drawings by the Engineer will not relieve Contractor in any way from its responsibility with regard to the fulfillment of the terms of Agreement. All risks of error are assumed by Contractor. The City and the Engineer shall have no responsibility therefor.

GC-28.4 Record Agreement Drawings

Contractor shall keep at least one (1) record copy of all Agreement Documents, reference documents, and all technical submittals at the Site in good order and annotated to show all changes made during the construction process. Record drawings shall be updated and kept current on a monthly basis by Contractor. The record drawings will be reviewed monthly by the Engineer prior to approval of Contractor's monthly Payment Application. Final "as-built" plans of the Work, shall be satisfactory to the Engineer, and will be provided at Contractor's expense within thirty (30) days following Substantial Completion of the Work or any portion thereof. The provision of such as-built documents satisfactory to the Engineer shall be an express condition precedent to final payment. Upon request, the Engineer will provide one (1) set of reproducible of the original Agreement Drawings, at no cost, to Contractor within two weeks subsequent to the execution of this Agreement.

GC-28.5 Samples

GC-28.5.1

Contractor shall furnish at no additional cost, for the approval of the City, samples required by the Agreement Documents or requested by the City. Samples shall be delivered to the City as specified or directed. Contractor shall prepay all shipping charges on samples. Materials or Equipment for which samples are required shall not be used in Work until approved by the City.

GC-28.5.2

Each sample shall have a label indicating:

- (1) Name of Project;
- (2) Name of Contractor and Subcontractor;
- (3) Material or Equipment Represented;

- (4) Place of Origin;
- (5) Name of Producer and Brand (if any); and
- (6) Location in Project.

GC-28.5.3

Contractor shall prepare a transmittal letter for each shipment of samples containing the information required in Article B above. It shall enclose a copy of this letter with the shipment and send a copy of this letter to the City. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any Agreement requirement. Substitutions will not be permitted unless they are considered to be to the City's best interest.

GC-28.5.4

Approved samples not destroyed in testing shall be sent to the City or stored at the Site of the Work. Approved samples of the hardware in good condition will be marked for identification and may be used in the Work. Materials and Equipment incorporated in the Work shall match the approved samples. Samples which failed testing or were not approved will be returned to Contractor at its expense if so requested at time of submission.

GC-28.5.5

Contractor will provide architectural samples to the City in a composite color board format for review and color coordination. These samples shall be of the precise Material and color specified and of sufficient size for comparison to other material samples.

GC-28.5.6

Custom colors and coatings may be required to complete the Project within acceptable architectural standards. Contractor shall comply with the Architect's selection and provide Materials that precisely match the approved samples.

GC-28.6 Operation and Maintenance Manuals

GC-28.6.1

Operation and maintenance manuals are operator and shop maintenance instructions that enable an average journeyman mechanic without prior knowledge of the specific type, make, or model to maintain and repair the Equipment. The manuals shall include repair parts data that provides positive identification for an item of the complete Equipment with reference to the manufacturer or dealer facilities to identify ordering part numbers in support of procured Equipment.

GC-28.6.2 Preparation Instructions

An operation and maintenance manual set is required to cover each specific make, model, year and serial numbered piece of Equipment scheduled for delivery under terms of this Agreement. It is the intent of these requirements to use standard commercial manuals modified to meet the minimum Specification set forth herein. The manuals shall provide instructions, illustrations, and other associated data for operations, preventive and corrective maintenance and repair, including a complete catalog of parts used in the assembly of the end item. The manuals provided shall contain complete instructions and information as set forth below for all Equipment components, assemblies, subassemblies, attachments, and accessories manufactured by the prime Supplier or those purchased by the prime Supplier from other sources and assembled in the finished end item.

GC-28.6.3 Contents of Operation and Maintenance Manuals

The contents of complete set of manuals shall include, at a minimum, the following:

- (1) Table of Contents;
- (2) Operating instructions;
- (3) Preventive maintenance, service, and corrective maintenance or repair instructions;
- (4) Parts list with recommended quantity; and
- (5) Approved Shop Drawing(s).

GC-28.6.4 Binding and Delivery

The manual(s) shall be bound or otherwise securely enclosed in an oil and moisture resistant binder(s). Each binder cover shall indicate in bold type the manufacturer's name, contract number, model number, and serial number of the unit or equipment. Five (5) copies of the manual(s) shall be delivered with the Shop Drawings and must be approved with the Shop Drawings.

GC-29 CONTRACTOR'S TITLE TO MATERIALS

No Materials or supplies for the Work shall be purchased by Contractor or by any Subcontractor subject to any chattel mortgage, security agreement, or under a conditional sales contract or other agreement by which any security interest is retained by the seller. Contractor warrants that it has good title to all Materials and supplies used in the Work, free from all liens, claims or encumbrances.

GC-30 INSPECTION AND TESTING OF MATERIALS

All Materials and Equipment used in the construction of the Project shall be subject to adequate inspection and testing in accordance with accepted standards and the requirements of the Agreement Documents. The laboratory and inspection agency shall be provided by Contractor and approved by the City for these tests; provided, however, that if the City has already secured the services of identified testing consultants/agencies, then Contractor shall engage the services of the testing consultant/agency designated by the City. Additional tests performed after rejection of Materials or Equipment shall be at Contractor's expense.

Materials of construction, particularly those upon which the strength and durability of the structure may depend, shall be subject to inspection and testing to establish conformance with Specifications and suitability for uses intended, but failure to inspect Materials will in no way waive the City's right to reject defective Materials or to condemn Work in which they are used. Contractor will provide for travel expenses, factory performed testing and set up costs for the factory inspection and testing of all major architectural elements, mechanical, electrical or process equipment. A factory visit for both designers' representative and a City representative may be required. No funds for stored materials or fabrication items will be released until the factory inspection is completed and a certified Payment Application is submitted.

All tests performed by Contractor shall be witnessed by the City unless the requirement therefor is waived in writing. Contractor shall give the City reasonable advance notice of all such tests. The City may perform additional tests on materials tested by Contractor, and Contractor shall furnish samples for this purpose as requested.

In the event that the City directs additional testing or inspection of the Work and the testing or inspection reveals that the Work is not in accordance with the Agreement Documents, Contractor shall pay for all costs of correction of the Work as well as for all costs of testing and inspection. In the event that any portion of Contractor's Work depends upon the Work of the City or any of its separate contractors, the Contractor agrees that the City's Work or that of its separate contractor is adequate and installed such that it is ready and sufficient in all respects to accept Contractor's Work, unless written notice of any defect or deficiency is provided by the Contractor to the City prior to the Contractor beginning performance of the Work.

GC-31 MATERIALS AND EQUIPMENT

Contractor shall furnish all Materials and Equipment to be incorporated into the Work. Only Materials and Equipment conforming to the requirements of the Drawings and Specifications shall be incorporated into the Work. Except as otherwise specified or approved in specific instances, all such Materials and Equipment shall be new and unused and of the highest quality available. Materials and Equipment for which no specific requirements are given in the Drawings or specifications shall be those best suited for the specified use, considering function, strength, durability and resistance to corrosion. Manufactured Materials and Equipment shall be obtained from sources which

are currently manufacturing such Materials or Equipment, except as otherwise approved in writing.

If so ordered by the Engineer, sources of Materials shall be approved by him before delivery from those sources is commenced. Approval of a source of Materials may be withdrawn by the Engineer at any time that the Materials delivered from that source are found to be defective, and Contractor shall thereupon cease all deliveries from that source.

Manufacturer's warranties, certifications, guarantees, manuals, instruction sheets and parts lists provided with Materials and Equipment shall be furnished to the Engineer before final payment is made and receipt of same is a condition precedent to any obligation to make final payment.

GC-32 STORAGE OF MATERIALS AND EQUIPMENT

Materials and Equipment to be incorporated in the Work shall be stored in such a manner as to preserve their quality and fitness for incorporation in the final project. They shall be stored in a manner acceptable to the Designer and Owner and in an accessible facility that allows inspection. If at any time the City determines that any Materials or Equipment are not being properly stored, they may issue a directive to correct the storage or reject the Material for incorporation in the Project. No additional payment will be made for storage requirements. No payment will be made on Materials stored improperly or replaced due to improper storage.

No Equipment may be stored outside without the express written permission of the City on that specific piece of equipment stating that unit's unique I.D. numbers.

For any Equipment or units that have rotating parts or bearing assemblies and must be stored for more than sixty (60) days, Contractor shall set up a schedule to manually rotate the units every fifteen (15) days and maintain a certification log to preserve the service life and warranties.

GC-33 REPORTS, RECORDS, AND DATA

GC-33.1 General

Contractor shall submit to the City schedules of quantities and costs, progress schedules, reports, estimates, records, certificates, and other data as the City may request concerning Work performed or to be performed under this Agreement.

GC-33.2 Payroll Reports

Contractor shall be required to furnish weekly payroll reports to the City, certifying conformance with the wage rates listed in the Specifications. The requirement applies

to Contractor, its Subcontractors, and any lower-tier Subcontractor providing labor at the site. These reports shall show completed payroll information, and such certificates and statements of compliance as required in the Federal Labor Standards and by the City relative to payrolls. The schedule of wage rates shall be posted on a bulletin board available to the workers.

GC-33.3 Contractor's Daily Reports

As soon as Contractor has started Work on the Project, it shall compile written daily reports of the Work performed the previous day by its employees, including the employees of Subcontractors.

The reports shall be prepared by Contractor's representative and shall bear his signature. Each report shall contain at least the following information:

- (1) Description of Work items and references to payment items;
- (2) Work forces and construction Equipment employed;
- (3) Materials and Equipment installed;
- (4) Work performed by Subcontractors; and
- (5) Description of any accidents, interruptions, impacts, delays, problems, visitors, impediments, etc. encountered or continued.

Contractor shall require similar reports from Subcontractors for each day on Site and shall attach copies to Contractor's Daily Report when submitted.

GC-34 CONTRACTOR'S SUPERVISION OF THE WORK

GC-34.1 General

Contractor shall provide competent, efficient supervision of the Work. All Work shall be performed in a skillful, workmanlike and orderly manner, and Contractor and its supervisory personnel shall enforce this requirement at all times.

GC-34.2 Contractor's Representative

Before beginning Work, Contractor shall notify the City in writing of one (1) person within its organization, satisfactory to the City, who shall have complete authority to supervise Work, to receive orders from the City, and to represent and act for Contractor in all matters arising under Agreement. Contractor shall not remove its representative without first designating, in writing, a new representative, who meets all of the foregoing requirements. Upon ten (10) days notice, the City or the Engineer may request replacement of Contractor's Representative if, in the City's opinion, it is necessary to ensure the timeliness or quality of the Work.

Contractor's representative shall normally be present at or about the Site of Work while the Work is in progress. Before leaving the Site of Work for any extended period, whether or not the Work is in progress, Contractor's representative shall notify the City, in writing, of the designation of an assistant, satisfactory to the City, with full authority to act for the representative in his absence, or shall make substitute arrangements satisfactory to the City. When neither Contractor, its representative, nor the

representative's authorized assistant is present on a part of Work, the superintendent, foreman, or other employee or Contractor in charge of that part of the Work shall be an authorized representative of Contractor for the purposes set forth above.

GC-35 SUBCONTRACTORS AND SUPPLIERS

Contractor may utilize the services of specialty Subcontractors on those parts of Work that, under normal contracting practices, are performed by specialty Subcontractors, except as otherwise required by the Agreement Documents.

In addition to the designation of Subcontractors in the proposal documents, Contractor shall submit to the City a listing of the Subcontractor name, full address and telephone number, contact person, class or trade of work, list of similar past projects worked on, including reference names, telephone numbers, and other information as applicable to that Subcontractor and the provisions of the Agreement Documents. Contractor shall make Subcontractor submittals sufficiently in advance of construction requirements to provide the Engineer and City with no less than sixty (60) days for review and appropriate action.

Contractor shall be as fully responsible to the City for the acts and omissions of all Subcontractors and Suppliers, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it. Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to Work to bind Subcontractors and Suppliers to Contractor by the terms of the General Conditions and other Agreement Documents, insofar as applicable to the work of Subcontractors and Suppliers, and to give Contractor the same power as regards terminating any subcontract that the City may exercise over Contractor under any provisions of the Agreement Documents.

Nothing contained in this Agreement shall create any contractual relation between any Subcontractor or Supplier and the City. The Contractor shall not award more than seventy-five percent (75%) of the Work to Subcontractors, provided that, to the extent that a more stringent standard is required in the Special Conditions, the more stringent standard shall control.

GC-36 INSPECTION OF WORK

GC-36.1 General

All of Work shall be subject to inspection by the City for conformity with the Drawings and Specifications, Working Drawings, Shop Drawings, data on Materials and Equipment, and material samples. Inspection of the balance of Work will be in accordance with this article, unless otherwise expressly indicated. Material tests and all

other specified tests will be considered part of the inspection process and shall be subject to all of the provisions of this clause.

GC-36.2 Engineer's Access to Work

The Engineer shall have access to, and may inspect Work at all times and places. He shall have access to, and may inspect, Materials and Equipment to be incorporated in Work at all times at the place of production or manufacture and at the shipping point, as well as at Site of Work.

The Engineer will designate the Materials and Equipment to be inspected at the place of production or manufacture. Contractor shall give the Engineer fourteen (14) days advance written notice of the start of manufacture or production of Materials and Equipment so designated. The Engineer's failure to so designate Materials and Equipment shall in no way limit his right to inspect them at the place of production or manufacture.

Contractor's Materials and Equipment contracts shall include a notice to the Supplier or Subcontractor of the inspection requirements of this clause.

GC-36.3 Cooperation And Safety

The Engineer will perform inspections in such manner as not to delay Work unnecessarily, and Contractor shall perform the Work in such manner as not to delay inspection unnecessarily. Contractor shall give the Engineer reasonable advance notice of operations requiring special inspection of a portion of Work at any time by reasonable advance notice to the Engineer.

If requested by the Engineer, Contractor shall submit written certification, in a form approved by the Engineer, that he has inspected the Work prior to inspection by the Engineer, and that it complies with the Agreement Documents.

Contractor shall bear any additional inspection costs resulting from Contractor's failure to have a portion of Work ready for inspection at the time requested by Contractor for its inspection, or from reinspection of any previously rejected portion of Work where the defects requiring such rejection were due to Contractor's fault or negligence. Such costs may be deducted, in whole or in part, from any money due or that may become due Contractor under the Agreement.

Contractor shall furnish the Engineer all reasonable facilities for his safety and convenience in inspecting the Work, at all times and at all places where inspection may take place. If the Engineer finds that conditions are unsafe for inspection at a particular location, he may, upon notice to Contractor, refuse to inspect in that location until such conditions are corrected. Contractor shall bear any additional costs incurred to permit subsequent inspection of any portion of Work covered or completed at the location after correction of the conditions, whether or not such portion of Work is found to meet the requirements of the Agreement Documents.

GC-36.4 Inspection of Covered or Completed Portions of Work

If so ordered in writing by the Engineer, Contractor shall uncover, remove, tear out, or disassemble, in whole or in part, any covered or completed portion of Work to permit its inspection. If that portion of Work is found to be defective or unauthorized, Contractor shall bear all costs of uncovering, removal, tearing out, or disassembly. If such portion of the Work is found to conform with the Agreement Documents, including Agreement Drawings and Specifications, it shall be recovered, replaced, reassembled, or otherwise restored by Contractor to its original condition and, except as stated below, all Work required in connection with the inspection will be considered extra Work. If such portion of Work was covered or completed without the approval of the Engineer, where such approval was required by the Specifications or required in advance by the Engineer, Contractor shall bear all costs involved in the inspection, notwithstanding conformance of such portion of Work with the Agreement Documents including the Agreement Drawings and Specifications.

GC-36.5 Inspection Not a Waiver or Acceptance

Neither the inspection nor lack of inspection of any portion of the Work, nor the presence or absence of the Engineer during performance of any of the Work, nor acceptance of the whole or any part of the Work by the Engineer, nor any possession taken by the City or its employees shall operate as a waiver of any provision of this Agreement Documents or any power herein reserved to City or any rights to damages herein provided. Should an error in the estimate, or conclusive proofs of defective Work or materials used by or on the part of Contractor be discovered after the final payment has been made, the City reserves the right to claim and recover by process of law such sums as may be sufficient to correct the error or to make good the defects in the Work and Materials.

GC-36.6 Correction of Non-Compliant Work

If Contractor is found to have Work that fails to meet the intent of the Plans and Specifications or other Agreement Documents, or is in other aspects unsuitable it may be issued a notice of non-compliance on that portion of the Project Work. Contractor shall remedy the defective or incorrect Work within twenty-four (24) hours unless a different schedule is agreed to in writing. This non-compliance status may be issued on temporary installations that fail to protect the Work or site conditions.

GC-37 CITY'S AUTHORITY

The City shall have authority to decide all questions as to interpretation and fulfillment of the requirements and obligations of the Agreement Documents, including, without limitation, all questions as to the prosecution, progress, quality, and acceptability of Work. The City may implement and enforce its decisions by orders, instructions, notices, and other appropriate means.

Any decision, order, instruction, or notice of the City will be confirmed in writing. Such confirmation shall state the specific subject of the decision, order, instruction, or notice and its date, time, place, author and recipient.

Inspectors may be appointed to inspect all Materials used and all Work performed. Such inspection may extend to all or any part of the Work and to the preparation or manufacture of the Materials to be used. Inspectors will not be authorized to approve or accept any portion of the completed Work or to issue instructions contrary to the Plans and Specifications or other Agreement Documents. Inspector will have authority to reject defective Material and to suspend Work that is being improperly performed, subject to the final decision of the City. Inspector shall, in no case, act as foreman or perform other duties for Contractor.

GC-38 PROGRESS PAYMENTS

GC-38.1 Progress Estimates

Within the time set forth in the Special Conditions or, if none, then prior to the submittal of the first Payment Application, Contractor shall submit to the Engineer for approval, in the form directed or acceptable to the Engineer, a complete schedule of values of the various portions of the Work, including quantities and unit prices, aggregating the Agreement Price (except in cases and to the extent that accepted unit prices form the basis of payment). The schedule shall subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction and to coordinate with the progress schedule required under the Special Conditions, and shall be supported by such data to substantiate its correctness as the Engineer may require. Each item in the schedule of values shall include its proper share of overhead and profit. An unbalanced breakdown providing for overpayment to Contractor on items of Work which would be performed first will not be approved. The schedule of values, when approved by the Engineer, shall be used only as a basis for Contractor's monthly request for payment and shall not be used as the basis for computing additions to or deductions from the Agreement Price.

Subject to the provisions of this clause, Contractor shall prepare a written report for the Engineer's approval, on the form approved by the City, of the total amount of value of Work performed under the proposal items of Agreement to the time of such estimate and in accordance with the progress report based on the approved schedule.

No progress estimate or payment shall be considered an approval or acceptance of any Work performed, Material, or Equipment furnished. All estimates and payment will be subject to correction in subsequent estimates and the final estimate.

Progress payments will be made for all completed activities and for suitably stored Materials as herein provided.

GC-38.2 Progress Payments

Upon completion of each monthly estimate of Work performed and Materials furnished, the Engineer, subject to the provisions of the Agreement Documents, shall recommend payment to Contractor for the estimated value of such Work, Materials, and Equipment, less the amount of all prior payments and all liquidated damages and other amounts to be deducted or retained under the Agreement. Contractor will be paid one hundred (100%) percent, less retainage, of the cost of Materials received and properly stored but not incorporated into the Work. Payments for Materials or Equipment stored on the Site shall be conditioned upon submission by Contractor of bills of sale or such other procedures satisfactory to the Engineer to establish the City's title to such Materials or Equipment or otherwise protect the City's interest, including applicable insurance. No progress estimate or payment needs to be made when, in the Engineer's judgment, the increment in the estimated value of Work performed and Materials and Equipment furnished since the preceding estimate is less than Ten Thousand Dollars (\$10,000.00). Contractor will be paid on or before the twenty-fifth day following receipt of the approved estimate from the Engineer.

GC-38.3 Retention from Progress Payments

The amounts retained by the City from each progress payment shall be as follows:

- (1) Except as noted below, withholding ten percent (10%) of the estimated value of the Work performed until 50 percent of the Contract value, including change orders and other additions to the Contract value provided for by the Contract Documents, is due and the manner of completion of the Contract Work and its progress are reasonably satisfactory to the City.
- (2) At the discretion of the City and with the approval of Contractor, the retainage of each Subcontractor may be released separately as the subcontractor completes his or her work.
- (3) Upon receipt of written request from Contractor, the City may, in its unilateral discretion, reduce retainage to Contractor for payment of retainage to Subcontractors who have completed their Work. If such retainage is released, Contractor shall furnish the City with an affidavit certifying that all monies due the Subcontractor have been paid. If the City determines that the released retainage has not been paid to the Subcontractor, the amount released shall be reinstated.
- (4) The City may, in its unilateral discretion, elect to reduce Contractor's retainage and that of Subcontractors who have not completed all their work if the City believes it to be in its interest to do so.
- (5) If reduced, the City may reinstate ten percent (10%) withholding if it believes it necessary or desirable to do so. Contractor agrees that the City is free to do so.
- (6) If, after discontinuing the retention, the City determines that the Work is unsatisfactory or has fallen behind schedule, retention may be resumed at the previous level. If retention is resumed, Contractor and Subcontractors shall be entitled to resume withholding retainage accordingly.

GC-38.4 Additional Payment Conditions

GC-38.4.1

The submission and approval of the CPM Schedule and periodic updates thereof, as required by the Schedule requirements of the Special Conditions, shall be an integral part and basic element of the application upon which Progress Payments shall be made. Contractor shall be entitled to Progress Payments only as determined from the currently approved and updated CPM Schedule.

GC-38.4.2

Contractor shall promptly pay each Subcontractor upon receipt of payment from the City, out of the amount paid to Contractor on account of such Subcontractor's Work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to Contractor on account of such Subcontractor's Work. Contractor shall, by an appropriate agreement with each Subcontractor, require each Subcontractor to make payments to their Subcontractors in similar manner.

GC-38.4.3

The City may, on request and at its discretion, furnish to any Subcontractor, if practicable, information regarding the percentages of completion or the amounts applied for by Contractor and the action taken thereon by the City on account of Work done by such Subcontractor.

GC-38.4.4

Neither the City nor the Engineer shall have any obligation to pay or to see to the payment of any Subcontractor or Supplier, but may at its sole option, withhold payment from Contractor on account of claims of nonpayment by Subcontractors and Suppliers in accordance with GC-38.5.1.

GC-38.4.5

No certification of Progress Payment (any progress payment), or any partial or entire use or occupancy of the Project by the City, shall constitute an acceptance or approval of any Work not fully in accordance with the Agreement Documents.

GC-38.4.6

Any and all funds paid to Contractor pursuant to the City-Contractor Agreement are hereby declared to constitute trust funds in the hands of Contractor, to be applied first to the payment of claims of Subcontractors, laborers, and Suppliers arising out of the Work, to claims for utilities furnished and taxes imposed, and to the payment of premiums on surety and other bonds and on insurance, before application to any other purpose. Whenever required by the Engineer, it shall be the duty of Contractor to file with the Engineer a verified statement, in form satisfactory to the Engineer, certifying the amounts then due and owing from

Contractor for labor and materials, setting forth therein the names of the person whose charges or claims for labor or materials are unpaid, and the undisputed amount due to each respectively. The City, at its option, may also require the Contractor to furnish evidence of payment of Subcontractors and Suppliers in any form satisfactory to the City in addition to the requirements of GC-38.6.

GC-38.4.7

No payments made hereunder by City to Contractor prior to Final Payment shall be deemed conclusive as to the actual value of the Work performed by Contractor or of Contractor's performance of the Agreement.

GC-38.4.8

City reserves the right to issue any Progress Payment and Final Payment by check jointly to Contractor and any Subcontractor or Supplier at City's option.

GC-38.4.9

Should the City fail to issue any Progress Payment within sixty (60) days of approval of an acceptable monthly estimate of Work performed and Materials furnished, annual interest on the payment amount may accrue at the Prime Rate, plus one percent. The Prime Rate shall be based on that published in the Wall Street Journal on the first business day of January or June, whichever has most recently passed, of the current year. Nothing stated herein shall invalidate any other conditions of Progress Payment approval.

GC-38.4.10

Contractor agrees to execute such payment application forms and release of claim forms as the City may require as a condition precedent to the City's obligation to make payment.

GC-38.4.11

This Article 38 shall completely supersede the Georgia Prompt Payment Act as it relates to Owner payments and any modifications or successors to it to the full extent allowed by law.

GC-38.5 Payments Withheld

GC-38.5.1

The City may decline to approve payment and may withhold any payment, in whole or in part, to the extent necessary to reasonably protect the City from loss because of:

- (1) Defective Work not remedied;
- (2) Third party claims filed or reasonable evidence indicating probable filing of such claims;

- (3) Failure of Contractor to make payments properly to Subcontractors, or for labor, Materials or Equipment;
- (4) Reasonable evidence that the Work cannot be completed for the unpaid balance of the Agreement Price;
- (5) Damage or the reasonable expectation of damage to the City or another contractor;
- (6) Reasonable evidence that the Work will not be completed within the Agreement Time;
- (7) Failure to carry out the Work in accordance with the Agreement Documents;
- (8) Failure of Contractor to fully comply with the Schedule requirements of the Special Conditions;
- (9) Failure to comply with insurance and safety requirements;
- (10) Failure to keep current "As-Built" Records; or
- (11) Failure of Contractor to comply with the requirements of the Agreement Documents in connection with the Payment Application process.

GC-38.5.2

When the grounds in Article GC-38.5.1., above are removed, payment shall be made for amounts withheld because of them.

GC-38.6 Waiver and Preservation of Claims In Periodic Application of Payments

Contractor has been employed by the City to furnish labor, Material, services, and other improvements. Upon receipt of the amounts requested in any monthly Application for Payment, Contractor waives and releases any and all claims it may have against the City or the Engineer through the date of that Payment Application, excepting those rights that Contractor may have in any retained amounts on account of labor or Materials, or both, furnished by Contractor and the unresolved claims, if any, enumerated in the Application for Payment. Contractor expressly warrants by submission of its periodic Application for Payment that all due and payable bills with respect to the Work have been paid to date or shall be paid from the proceeds of the Application for Payment, and waivers and releases from all Subcontractors and material men have been or will be obtained and delivered to the City in such form as to constitute effective waivers and releases of claims under all applicable laws. Upon receipt of payment of the amounts certified in the Application for Payment, Contractor does thereby waive, release, and relinquish any claims for additional compensation or an extension of time which Contractor has then or may have had arising out of the performance of the work or the furnishing of the labor or materials by Contractor through the date of the Application for Payment. This waiver and release applies to all facts, events, circumstances, changes, constructive or actual delays, acceleration, extra work, disruption, interferences, impacts and the like, which have occurred or may be claimed to have occurred prior to the date of the Application for Payment, excepting only claims which are then currently unresolved for which written notice has previously been provided to the City **and** which Contractor specifically enumerates in its Application for

Payment. Failure to so enumerate claims shall be a final waiver and relinquishment of claim, whether or not such claims were previously submitted in accordance with GC-41.

GC-39 SUBSTANTIAL COMPLETION (“Substantial Completion”)

GC-39.1 Certificate of Substantial Completion

When Contractor considers that the Work, or a designated portion thereof which is acceptable to the City, is Substantially Complete, Contractor shall prepare for the Engineer a list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of Contractor to complete all Work in accordance with the Agreement Documents. When the Engineer, on the basis of an inspection, determines that the Work or designated portion thereof is Substantially Complete, they will then prepare a Certificate of Substantial Completion of the Work which shall establish the Date of Substantial Completion of the Work, shall state the responsibilities of the City and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance and shall fix the time within which Contractor shall complete the items listed therein. The Certificate of Substantial Completion of the Work shall be submitted to the City and Contractor for their written acceptance of the responsibilities assigned to them in such Certificate.

GC-39.2 Warranty Commencement

Warranties required by the Agreement Documents shall commence on the Date of Final Completion of the Project or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion of the Work or designated portion thereof.

GC-39.3 Intentionally Omitted

GC-40 FINAL PAYMENT (“Final Payment”)

GC-40.1 Certificate for Final Payment

Following the Engineer's issuance of the certificate of Substantial Completion of the Work or designated portion thereof, and Contractor's Completion of the Work, Contractor shall forward to the Engineer a Written Notice that the Work is ready for final inspection and acceptance, and shall also forward to the Engineer a final Application for Payment. Upon receipt, the Engineer will make the necessary evaluations. When the Engineer finds the Work acceptable under the Agreement Documents and the Agreement fully performed, the Engineer will issue a certificate for Payment that will approve the final Payment due Contractor (“Final Payment”).

GC-40.2 Final Payment Conditions

Neither the Final Payment nor the retainage shall become due until Contractor submits to the Engineer:

- (1) An affidavit that all payrolls, bills for Materials and Equipment, and other indebtedness connected with the Work have been paid or otherwise satisfied;
- (2) Consent of surety, if any, to Final Payment;
- (3) Clear title for all vehicles and/or trailers, if any, to remain as City property;
- (4) Complete set of as-built record Drawings;
- (5) Documentation for all state sales taxes paid by Contractor including completed State Department of Revenue Refund forms and all necessary back up documentation required by the Department of Revenue;
- (6) If required by the Engineer or City, other data establishing payment or satisfaction of all such obligations, such as receipts, releases, and waivers of liens arising out of the Agreement, to the extent and in such form as may be designated by the Engineer or City. If any Subcontractor refuses to furnish a release or waiver required by the Engineer or City, Contractor may furnish a bond satisfactory to the City to indemnify the City against any such loss. If any lien or indebtedness remains unsatisfied after all payments are made, Contractor shall refund to the City all monies that the latter may be compelled to pay in discharging such lien or other indebtedness, including, without limitation, all costs, expenses, arbitration fees, reasonable attorneys' fees, expert fees, or consultant fees incurred in connection with same; and
- (7) As a condition of Final Payment on the Project, Contractor shall, prior to final payment, complete and submit to the City, all of the invoice documentation and the State of Georgia Revenue Department forms required to obtain the sales tax refund on all applicable equipment expenditures. This submittal shall include the certified forms and auditable back-up necessary to substantiate the expenditures for State refund.

GC-40.3 Intentionally Omitted

GC-40.4 Waiver of Claims by Contractor Upon Final Payment

The acceptance of Final Payment shall constitute a waiver of all claims by Contractor except those previously made in writing and identified **and** enumerated by Contractor as unsettled at the time of the application for Final Payment. Failure to so enumerate unsettled claims shall be a final waiver and relinquishment of claim, whether or not such claims were previously submitted in accordance with GC-41.

GC-41 CLAIMS, CHANGES, AND EXTRA WORK

Contractor acknowledges the extreme importance to Owner of identifying and resolving Claims on an "as-you-go" basis in order for Owner to maintain its relationship with all available funding sources, including local taxpayers as well as the state and federal governments. Contractor further acknowledges the extreme prejudice suffered by Owner as a result of any attempted assertion by Contractor of Claims except as

specifically permitted herein in the precise manner and within the time limits established herein, which prejudice includes, but is not limited to that resulting from the trouble and expense of having to deal with disputes over claims, if any, that were not made in accordance with the precise manner and within the time established herein.

GC-41.1 Claims and Contractor's Obligation to Proceed in the Face of Disputes

GC-41.1.1

A claim is any demand, contention, or assertion by Contractor seeking additional time or money under the Agreement Documents. Claims by Contractor must be made in writing as specified herein. Claims from Contractor must contain all of the following:

- (1) A narrative statement referencing and attaching the supporting documentation and specifically describing the legal, factual, and contractual basis of the claim;
- (2) If the claim alleges delay to the work or requests an extension time for excusable delay, the claim must include the precise number of days claimed, all alleged impacts on the work, as well as a detailed critical path as-built schedule analysis illustrating that the delays claimed were on the critical path of the Project, and that no concurrent delays were experienced during the critical path delay;
- (3) If the claim alleges improper acceleration of the work pursuant to GC-27.2, the claim must include the precise number of days' time extension Contractor contends it would have been entitled to receive, but for the acceleration, and the precise number of days by which the work has been accelerated. No claims for acceleration for work that is not on the critical path shall be permitted. Claims for acceleration must be accompanied by a detailed CPM analysis. Claims for acceleration shall be limited to the recoverable acceleration expenses referenced in Article GC-27 of this Agreement; and
- (4) If the claim is for additional compensation, the claim must include a detailed calculation of the precise amount claimed with all supporting documentation and shall also comply with Atlanta Procurement Code §2-1201 for claims expected to exceed \$20,000.00. All claims must reference the specific contract provisions relied upon to support the claim. Claims that are not based upon a contractual provision or remedy shall be void as Contractor agrees that its entitlement is limited to the remedies offered by the terms of this Agreement. All claims must specifically reference, by name, this Article, and the fact that the claim is being submitted under this Article. Any writing or other form of notice, however designated, which fails to specifically reference this Article, by name, shall not be deemed to constitute a valid claim hereunder.

Items (1), (2), (3) and (4) above shall hereinafter be referred to as the "Final Accounting."

Initial written notice of Contractor's intent to assert a claim (the "Initial Notice") must be made in writing within seven (7) days after the occurrence of the event giving rise to the claim or the right to submit a claim is waived. Contractor shall submit all information reasonably available to it that is otherwise required in the Final Accounting at the time of the Initial Notice.

Except for Claim events that continue more than thirty (30) days, within thirty (30) days after the conclusion of the event giving rise to the Claim, Contractor shall provide the Final Accounting. Failure to timely provide the Final Accounting shall constitute a waiver of the Claim even if timely Initial Notice is provided. Any waiver by the City of the notice requirements for the Initial Notice or the Final Accounting for a single claim, event, or occurrence shall not constitute a waiver of these notice requirements for any other claim, event, or occurrence. Each request for time or money by Contractor shall be considered a separate claim. All information required in the Final Accounting must be submitted within the time limits established herein, and no supplementation of the information or claims shall be permitted. Any attempted reservation of the right to submit or supplement an earlier made claim shall be void.

For events giving rise to a claim that Contractor contends continues for more than thirty (30) days, including any alleged continuing claims or continuing impacts that Contractor contends continue to accrue beyond thirty (30) days, then Contractor shall give the Initial Notice as required herein, stating therein that the event or impact is continuing. Within thirty (30) days of the start of the event (as documented by the Initial Notice), Contractor shall provide all information available to it that is required in the Final Accounting, including without limitation a quantification of any costs incurred to date. Contractor shall supplement the required information, including without limitation any additional damages accrued during the period and any scheduling information required, every thirty (30) days thereafter until the event or impact ceases, culminating in the Final Accounting within thirty (30) days thereafter. Failure to timely provide: (a) the Initial Notice; (b) the information due within thirty (30) days thereafter; (c) timely and complete supplements; or (d) the timely Final Accounting shall be deemed a waiver of any claim for time or money for events occurring after the date Contractor last timely and completely complied with the requirements hereof. Any attempt to reserve the right to supplement at a different time or to accrue costs or impacts beyond thirty (30) days shall be void and shall be deemed a waiver of any further claim relating thereto.

The Final Accounting shall be accompanied by a sworn statement from a representative of Contractor who is the person most knowledgeable of the

facts and circumstances surrounding the Claim and personally familiar with such facts and circumstances certifying that (a) the claim is submitted in good faith, (b) the cost data and all backup information submitted are true, accurate, and complete, and (c) that the amount requested accurately reflects the amount for which Contractor and the Affiant believe the City is liable.

GC-41.1.2 Claim Review

Upon receiving a statement of claim, and with the advice and assistance of the Engineer as appropriate, the City may review the statement of claim submitted by Contractor. In conducting this review, the Engineer or other person designated by the City shall have the right to require Contractor to submit such additional or supporting documents, data and other information as the City and/or the Engineer may require, and the failure to submit such additional documents, data or other information within thirty (30) days following written request shall be deemed a waiver of the claim. Contractor agrees that it will produce any documents requested that would otherwise be produceable in a civil action under O.C.G.A. § 9-11-34. Upon completion of such review, to take place within such time as the City may designate following receipt of the additional documents, data or other information as may have been required by the City and/or the Engineer, the City in consultation with the Engineer may issue a written determination, and if it deems appropriate accept such parts of the claim as are found in good faith to be proper. If Contractor agrees, a Change Order shall be issued to amend the Agreement Price, the time for completion or either of them as may be found proper. If Contractor disputes the determination made by the City, Contractor as a condition precedent to any further action to resolve such dispute must notify the City and the Engineer in writing within ten (10) days following receipt of the decision of the factual basis of such dispute and permit the City fifteen (15) additional days to reconsider and, if it deems it appropriate, issue a modified decision.

GC-41.1.3 No Waiver

Nothing contained in this section shall operate to limit or extinguish any right or defense of the City contained elsewhere in the Agreement Documents or available at law or in equity or constitute a waiver by the City of any right or defense otherwise available. Nothing in this Article GC-41 shall alter Article GC-24 or GC-26 or give Contractor the right to recover additional compensation not authorized by other items of the Contract Documents or precluded thereby.

GC-41.1.4 Absolute Conditions Precedent

The failure of Contractor to file any claim within the time limits prescribed herein or in the form or manner precisely as required hereby shall be deemed a material prejudice to the interests of the City and shall constitute an absolute waiver of the claim and the right to file or thereafter prosecute the same.

GC-41.1.5

Claims by the Owner shall not be subject to the requirements of Section 41.1, Claims by the Owner shall be asserted within a reasonable time of discovery of the claim and shall include information necessary for Contractor to reasonably evaluate the claim. The Owner agrees to notify Contractor in writing of its claims within a reasonable time but not later than the close of discovery in any arbitration or litigation conducted hereunder.

GC-41.1.6

Pending final resolution of a Claim, except as otherwise agreed in writing, Contractor shall proceed diligently with performance of the Work and the Owner shall continue to make undisputed payments in accordance with the Agreement Documents. The making of any payment by Owner shall not constitute a waiver of any Claims by the Owner or an acknowledgement by Owner that Contractor is entitled to additional time or money.

GC-41.1.7

Contractor acknowledges the extreme importance to the City of completing the Work as expeditiously as possible and the prejudice the City may suffer if the Work is not completed as scheduled. Contractor further acknowledges the strong likelihood that disputes between the parties will arise and that Contractor will likely be required to perform disputed work which the City contends to be included within Contractor's scope of work, or that if acknowledged as changed or extra work, the likelihood that the City may dispute the amount of Contractor's alleged entitlement. Irrespective of whether it is within the general scope of the Work, Contractor agrees to perform all work, whether disputed or undisputed, that the City directs. No dispute or controversy shall interfere with the progress of construction, and Contractor shall proceed with the work without interruption, deficiency, or delay. Contractor warrants and represents that Contractor and its Surety have sufficient capitalization and resources to complete the Work, including all disputed work whether or not it is within the general scope of the work, and resolve disputes in accordance with the terms of this Agreement. Contractor therefore agrees that any failure or refusal by Contractor to perform disputed work which the City directs Contractor to perform shall be a material and substantial breach of the Agreement for which Contractor and its surety are jointly and severally liable. Contractor acknowledges and agrees that its failure or refusal to perform disputed work will cause the City significant damage and that such damages may include increased costs to have another contractor complete the work at a premium over the costs Contractor would have incurred to perform the disputed work. Contractor acknowledges and agrees that should it refuse to proceed in the face of disputes, it is liable for all additional costs incurred in completing both Contractor's base Agreement scope of work and any changed, extra, or additional work.

GC-41.2 Changes in the Work

GC-41.2.1 General

GC-41.2.1.1

Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Agreement, by Change Order, Field Change, Work Authorization or Change Directive. For purposes of this Agreement, the terms “extra work” or “additional work” shall have the same meaning as “changed work” and be governed by the same Agreement provisions governing changes.

GC-41.2.1.2

Changes in the Work shall be performed under applicable provisions of the Agreement Documents, and Contractor shall proceed promptly, unless otherwise provided in the Change Order, Field Change, Work Authorization or Change Directive. A change in the Agreement Price or the Agreement Time shall be accomplished only by Change Order or Change Directive, and no other compensation shall be due to Contractor other than that permitted pursuant to a Change Order or a Change Directive. Accordingly, no course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work, and no claim that Owner has been unjustly enriched by any change to the Work, whether or not there is, in fact, any unjust enrichment, shall be the basis of any claim for an increase in any amounts due under the Agreement Documents or a change in any time period provided for the Agreement Documents. Any failure to comply with the notice and other claim procedure requirements included herein or any other Agreement requirements shall be a waiver of the right to additional time or money.

GC-41.2.1.3

Any written directive which Contractor believes to constitute a Change hereunder must be accompanied by the notice required under Article GC-41 governing claims. ALL CONTRACTOR CLAIMS FOR CHANGES MUST BE ASSERTED IN ACCORDANCE WITH ARTICLE GC-41 OR THEY ARE WAIVED AND RELEASED.

GC-41.2.2 Change Orders

GC-41.2.2.1 [Intentionally Omitted]

GC-41.2.2.2 [Intentionally Deleted]

GC-41.2.2.3

Methods used in determining adjustments to the Agreement Price for Change Orders shall be limited to those listed, below:

Any Change Order accepted by Owner and Contractor constitutes a full and final settlement and accord and satisfaction of all effects of the change, including but not limited to any and all impact, delay and/or disruption relating thereto upon any and all aspects of the Work or the Agreement Documents, and will compensate Contractor fully. In such case, Contractor expressly waives any and all right to make a Claim or to take any action or proceeding for any other consequences of any Change Order, whether the consequences result directly or indirectly from the Change Order. In addition, Contractor expressly waives and releases any Claim it may have against the Owner for any adjustment in the Substantial Completion Date or Final Completion Date resulting from, arising out of, or related to the change reflected in any such Change Order, including, but not limited to, any impact that such change may have on the unchanged portion of the Work or the Substantial or Final Completion Date. In addition, Contractor expressly waives and releases any Claim it may have against the Owner for any additional compensation or damages resulting from, arising out of, or related to, the change reflected in any such Change Order, including, but not limited to any Claim for damages due to delay, disruption, hindrance, impact, ripple effect, cumulative impact, interference, cardinal change, abandonment, inefficiencies or extra work arising out of, resulting from, or related to the change reflected in any such Change Order, including, but not limited to, any impact that such change may have on the unchanged portion of the Work or the Substantial or Final Completion Date.

GC-41.2.3 Change Directives

GC-41.2.3.1

The Owner may, by Change Directive, without invalidating the Contract, order Changes in the Work consisting of additions, deletions or other revisions, the Agreement Price and Agreement Time being adjusted accordingly to the extent necessary. Any Claim arising from a Change Directive must be made in accordance with the terms of this Contract.

GC-41.2.3.2

A Change Directive shall be used in the absence of total agreement on the terms of a Change Order, Field Change, or Work Authorization.

GC-41.2.3.3

If the Change Directive warrants an adjustment to the Agreement Price, the adjustment shall be based on one of the following methods:

- (1) Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

- (2) Unit prices stated in the Agreement Documents or subsequently agreed upon;
- (3) Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- (4) By Force Account as provided hereafter.

GC-41.2.4 Force Account

When no agreement is reached for Changed Work to be done at Lump Sum or Unit Prices or another mutually agreed manner, such work may be authorized by the City to be done on a Force Account basis. A Force Account estimate that identifies all anticipated costs shall be prepared by Contractor. Work shall not begin until the Force Account is approved. Payment for Force Account work will be in accordance with the following:

GC-41.2.4.1 Labor

For all labor, equipment operators, and supervisors, excluding superintendents, in direct charge of the specific operations, Contractor shall receive the rate of wage agreed upon in writing before beginning work for each and every hour that said labor, equipment operators, and supervisors are actually engaged in such work.

Contractor shall receive the actual costs paid to, or in behalf of, workers by reason of subsistence and travel allowances, health and welfare benefits, pension fund benefits, or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on The Work.

An amount equal to 10% of the sum of the above items will also be paid Contractor. Said 10% shall be deemed to include 3% for Contractor's fee and 7% for Contractor's overhead.

GC-41.2.4.2 Bond, Insurance, and Tax

For bond premiums, property damage, liability, and worker's compensation insurance premiums, unemployment insurance contributions, and Social Security taxes on the Force Account work, Contractor shall receive the actual cost, to which cost no percentage will be added. Contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance, and tax.

GC-41.2.4.3 Materials

For materials accepted by the Engineer and used, Contractor shall receive the actual cost of such material incorporated into The Work,

including Contractor paid transportation charges (exclusive of machinery rentals as hereinafter set forth), to which cost 10% will be added. Said 10% shall be deemed to include 3% for Contractor's fee and 7% for Contractor's overhead.

GC-41.2.4.4 Equipment

For any machinery or special equipment (other than small tools) including fuel and lubricant, plus transportation costs, the use of which has been authorized by the Engineer, Contractor shall receive the rental rates indicated below for the actual time that such equipment is in operation on the Work or the time, as indicated below, the equipment is directed to stand by.

Equipment rates shall be based on the edition in effect at the time of Contractor's original bid of the *Rental Rate Blue Book for Construction Equipment* or *Rental Rate Blue Book for Older Construction Equipment*, whichever applies, as published by EquipmentWatch using all instructions and adjustments contained therein and as modified below.

Allowable Equipment Rates shall be established as defined below:

- Allowable Hourly Equipment Rate = Monthly Rate/176 x Adjustment factors x 70%.
- Allowable Hourly Operating Cost = Hourly Operating Cost x 70%.
- Allowable Rate Per Hour = Allowable Hourly Equipment Rate + allowable Hourly Operating Cost.
- Standby Rate = Allowable Hourly Equipment Rate x 35%

NOTE: The monthly rate is the basic machine plus any attachments.

Standby rates shall apply when equipment is not in operation and is directed by the Engineer to standby for later use. In general, Standby rates shall apply when equipment is not in use, but will be needed again to complete The Work and the cost of moving the equipment will exceed the accumulated standby cost. Payment for standby time will not be made on any day the equipment operates for 8 or more hours. For equipment accumulating less than 8 hours operating time on any normal workday, standby payment will be limited to only that number of hours which, when added to the operating time for that day equals 8 hours. Standby payment will not be made on days that are not normally considered workdays.

The City will not approve any rates in excess of the rates as outlined above.

Payable time periods will not include:

- Time elapsed while equipment is broken down;
- Time spent in repairing equipment; or
- Time elapsed after the Engineer has advised Contractor the equipment is no longer needed.

If a piece of equipment is needed which is not included in the above *Blue Book* rental rates, reasonable rates shall be agreed upon in writing before the equipment is used. All equipment charges by persons or firms other than Contractor shall be supported by invoices.

Transportation charges for each piece of equipment to and from the site of the Work will be paid provided:

- The equipment is obtained from the nearest approved source;
- The return charges do not exceed the delivery charges;
- Haul rates do not exceed the established rates of licensed haulers; and
- Such charges are restricted to those units of equipment not already available and not on or near the Project.

No additional compensation will be made for equipment repair.

GC-41.2.4.5 Miscellaneous

No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

GC-41.2.4.6 Compensation

Contractor's representative and the Engineer shall compare records and agree on the cost of work done as ordered on a Force Account basis at the end of each day. Should Contractor fail or refuse to fulfill this daily record keeping function by meeting with the Engineer and agreeing upon the cost of Force Account Work, Contractor agrees that it forfeits and releases any right to payment or right to claim for the Force Account Work for that day.

GC-41.2.4.7 Subcontract Force Account Work

For work performed by an approved Subcontractor or lower-tier Subcontractor, all provisions of this Section that apply to Contractor in respect to labor, materials and equipment shall govern. Contractor shall coordinate the work of its Subcontractor. The prime Contractor will be allowed an amount to cover administrative cost equal to 5% of

the Subcontractor's amount earned but not to exceed \$5,000.00 per Subcontractor for each Change in Work performed by Force Account. Markup for lower-tier Subcontract work will not be allowed. The 5% shall be for Contractor's overhead in administering the change.

Should it become necessary for Contractor or Subcontractor to hire a firm to perform a specialized type of work or service which Contractor or Subcontractor is not qualified to perform, payment will be made at reasonable invoice cost. To each invoice cost a markup to cover administrative cost equal to 5% of the total invoice but not to exceed \$5,000.00 will be allowed Contractor or Subcontractor but not both. If paid to Contractor, the 5% shall be for Contractor's overhead in administering the change.

GC-41.2.4.8 Statements

No payment will be made for work performed on a Force Account basis until Contractor has furnished the Engineer with duplicate itemized statements of the cost of such Force Account work detailed as follows:

- (1) Name, classification, date, daily hours, total hours, rate, and extension for each laborer, equipment operator, and supervisor, excluding superintendents;
- (2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment;
- (3) Quantities of materials, prices, and extensions;
- (4) Transportation of materials; and
- (5) Cost of property damage, liability, and worker's compensation insurance premiums, unemployment insurance contributions, and Social Security tax.

Statements shall be accompanied and supported by invoices for all materials used and transportation charges. However, if materials used on the Force Account work are not purchased specifically for such work but are taken from Contractor's stock, then, in lieu of the invoices, Contractor shall furnish an affidavit certifying that such materials were taken from its stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to Contractor.

Payment based on Force Account records shall constitute full payment and settlement of all additional costs and expenses caused by, arising from, or associated with the Work performed, including any time related or impact costs in connection with the Force Account work or any unchanged work impacted thereby.

GC-41.2.5

If any change or Change Directive meets the requirements for excusable delay and a change in the Agreement Time is warranted as a direct result of the change or Change Directive, then the four items of delay damage compensation identified in Article GC-26.2.1 for the unenforceability exception to the recoverability of delay damages under the Agreement may be included as a part of the adjustment in the Agreement Price for the change or change directive if Contractor has met all other requirements of the Agreement, including the notice and claim procedure requirements. Provided, however, Contractor shall, under no circumstances, be allowed to duplicate any costs included under this Article so as to receive a double recovery. In the event that Contractor is entitled to the four items of delay damage compensation referenced above, there shall be deducted from said entitlement all amounts paid or allowed Contractor for overhead pursuant to the percentage markups included herein.

GC-41.2.6

Upon receipt of a Change Directive, Contractor shall promptly proceed with the Change in the Work involved and advise the Owner of Contractor's agreement or disagreement with the method, if any, provided in the Change Directive for determining the proposed adjustment in the Agreement Price or Agreement Time utilizing the notice and claim procedures set forth herein.

GC-41.2.7

A Change Directive signed by Contractor indicates the agreement of Contractor therewith, including adjustment in Agreement Price and Agreement Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order, Field Change or Work Authorization, as applicable.

GC-41.2.8

If Contractor does not respond promptly or disagrees with the method for adjustment in the Agreement Price, the method and the adjustment shall be based upon the actual expenditures and savings attributable to the change, as determined in accordance with Article 41.2.4.

GC-41.2.9

The amount of credit to be allowed by Contractor to the Owner for a deletion or change which results in a net decrease in the Agreement Price shall be the actual cost, and that proportion of Contractor's Fee (including both profit and overhead) allocable to such actual cost.

GC-41.2.10

Pending final determination of the total cost of a Change Directive to the Owner, amounts not in dispute for such changes in the Work may be included in

Applications for Payment accompanied by a Change Order, Field Change or Work Authorization (as applicable) indicating the parties' agreement with part or all of such costs. For any portion of such cost that remains in dispute, the Owner may make an interim determination for purposes of monthly certification for payment for those costs. That interim determination of cost, if made, shall be subject to the right of the Owner to change or withdraw the same unless and until finalized by Change Order, Field Change or Work Authorization, as applicable.

GC-41.2.11

When Contractor agrees with the determination made by the Owner concerning the adjustments in the Agreement Price and Agreement Time, if any, or Owner and Contractor otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order, Field Change or Work Authorization, as applicable.

GC-41.3 No Oral Changes

It is expressly agreed that, except in an emergency endangering life or property, no modifications, additions or changes to the Work shall be made except upon written order of Contractor, and Contractor shall not be liable to Subcontractor for any extra labor, materials or equipment furnished without such written order. No officer, employee or agent of Contractor is authorized to direct any extra or Changed work by verbal order nor is Subcontractor authorized to proceed with any work upon verbal order.

No eliminations, additions, or alterations shall be made in the Work except upon written order of The City. No course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work, and no claim that the City has been unjustly enriched by any alteration or addition to the Work, whether or not there is, in fact, any unjust enrichment to the Work, shall be the basis of any claim for an increase in any amounts due under the Agreement Documents or an increase in any time period provided for in the Agreement Documents. No action, conduct, omission, prior failure, or course of dealing by the City shall waive, modify, change, or alter the requirement that Change Orders, Field Changes, Work Authorizations and Change Directives must be in writing signed by the City and/or Contractor, and that written Change Orders are the exclusive methods for effecting any change to the Agreement Price or Agreement Time. Contractor understands and agrees that the Agreement Price and Agreement Time cannot be changed by implication, oral contracts, verbal directives, actions, inactions, course of conduct, or constructive change order. Contractor shall be under no obligation to perform pursuant to an oral directive to perform work in addition to the Project scope excepting the case of an emergency threatening personal injury or property damage. Contractor acknowledges and agrees that no one in the City's organization has the authority to order changes without a signed writing.

GC-42 WORK AUTHORIZATIONS

When directed by the City's Representative through a Work Authorization, the Contractor will perform Work that is expressly or generally contemplated under any allowance or contingency items designated by the Agreement Documents, which may include a Change for the addition of Work that does not result in an increase in the overall Agreement Price. Work Authorizations may include Work items that are not necessarily shown in the Agreement Documents, but may be necessary for the successful completion of the Project. The performance of the Work Authorization items must conform to the standards of the Agreement Documents. The funding for Work Authorizations is an allowance only and not a compensable pay item. The City is solely responsible for the appropriation of the funds. The Contractor shall have no claims to such funds. The City will retain ownership of any such funds not used after the completion of Work. The Work shall be assigned and directed by the City's Representative in written form. Measurement, Payment, Invoicing and Pricing of Adjustments for Work Authorizations will be in accordance with the Agreement Documents.

GC-43 OWNERSHIP AND USE OF DOCUMENTS

All Contract Documents furnished to the Contractor remain the property of the City. The Contract Documents are to be used only with respect to this Project and are not to be used on any other project. All Contract Documents are to be returned to the City upon request at the completion of the Work. The Contractor may maintain a record set of the Contract Documents for its records, but will maintain the confidentiality of the record set, except as required by law. The Contractor can use the Contract Documents for any purposes required for the Project that will not be considered publication in derogation of the common law copyright or other reserved rights of the holder.

Neither Contractor nor any Subcontractor, Sub-Subcontractor, Supplier, vendor or other person or organization performing or furnishing any of the Work under a direct or indirect contract with City acquires any title to or ownership rights in any of the Contract Documents. The Contractor may not reuse the Contract Documents for extensions of the Project or for any other project without written consent of the City.

GC-44 CHANGED CONDITIONS

Contractor shall notify the Engineer in writing of the following conditions, hereinafter called "changed conditions," promptly upon their discovery and before they are disturbed, in any event no later than seven (7) calendar days after their discovery:

- (1) Subsurface or latent physical conditions at the site of Work differing materially from those indicated in this Agreement; or
- (2) Unknown physical conditions at the site of the Work of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in Work of the character provided for in the Agreement.

The Engineer shall promptly investigate the conditions, and if he finds that such conditions do materially so differ and cause an increase or decrease in Contractor's cost of, or the time required for, performance of any part of the Work under this Agreement, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the Agreement modified in writing in accordance with the provisions of this Agreement, subject to the provisions regarding Change Orders, Change Directives, notice and claims procedure and excusable delays. If the Engineer determines that conditions of which he has been notified by Contractor do not justify an adjustment in compensation, he will so advise Contractor in writing. Should Contractor disagree with such determination, it may submit a notice of claim to the Engineer as provided herein and follow the claims procedures of Article GC-41.

In computing any equitable adjustment sought by Contractor, the actual costs incurred by Contractor, computed in accordance with the Force Account provisions for changes shall be the standard for determining Contractor's entitlement. Provided, however, that if the City shows that conditions encountered by Contractor on the Project were more favorable and less costly than what Contractor reasonably should have expected to encounter, the net effect on Contractor from both the favorable and unfavorable conditions shall be considered in determining the amount of any equitable adjustment.

GC-45 INTENTIONALLY OMITTED

GC-46 INTENTIONALLY OMITTED

GC-47 INTENTIONALLY OMITTED

GC-48 INTENTIONALLY OMITTED

GC-49 MEASUREMENT AND PAYMENT

GC-49.1 Measurement

All items of Work to be paid for at Agreement Prices per unit of measurement will be measured or certified by the Engineer.

GC-49.2 Payment at Agreement Prices

The Agreement prices for items of Work shall include full compensation for all costs of items, including the costs for any Work, Materials and Equipment incidental to the items but not specifically shown or described in the Drawings and Specifications, subject only to such express limitations as may be stated in the Specifications defining the items or prescribing payment thereof.

GC-50 HISTORICAL, SCIENTIFIC, AND ARCHEOLOGICAL DISCOVERIES

All articles of historical or scientific value, including, but not limited to, coins, fossils, articles of antiquity, which may be uncovered by Contractor during process of Work, shall become the property of City. Such findings shall be reported immediately to the Engineer who will determine the further operations of Contractor, the method of removal, where necessary, and the final disposition thereof.

GC-51 SEPARATE AGREEMENTS

GC-51.1 Separate Contractors

The City reserves the right to award other Agreements in connection with this Project. Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate its Work with theirs. If the proper execution of any part of Contractor's Work depends upon the work of another contractor, Contractor shall inspect and promptly report to the Engineer any defects in such work that render it unsuitable for such proper execution and results.

GC-51.2 Cooperation

The City may perform additional work related to the Project by itself, or it may let other contracts containing provisions similar to these. Contractor shall afford the other contractors who are parties to such contracts and/or the City, if it is performing the additional work itself, reasonable opportunity for the introduction and storage of materials and equipment and the execution of work and shall properly connect and coordinate its work with theirs.

GC-51.3 Review of Separate Contractor's Work

If any part of Contractor's Work depends for proper execution or results upon the work of the City or any separate contractor, Contractor shall, prior to proceeding with the Work, promptly report to the Engineer any apparent discrepancies or defects in such other work that render it unsuitable for such proper execution and results. Failure of Contractor so to report shall constitute an acceptance of the City's or separate contractor's work as fit and proper to receive the work, except as to defects which may subsequently become apparent in such work by others.

GC-51.4 Notice to Contractor

If the performance of additional work by other contractors of the City is not noted in the Agreement Documents prior to the execution of the Agreement, Written Notice thereof shall be given to Contractor prior to starting any such additional work.

GC-51.5 Damage to Separate Contractor

Should Contractor wrongfully delay, impact, or cause damage to the work or property of any separate contractor, Contractor shall, upon due notice, promptly attempt to settle

with such other contractor by agreement, or otherwise to resolve the dispute. If such separate contractor sues or initiates a proceeding against the City or the Engineer on account of any delay or damage alleged to have been caused by Contractor, the City shall notify Contractor, who shall defend such proceedings at Contractor's expense, and if any judgment or award against the City or the Engineer arises therefrom, Contractor shall pay or satisfy it and shall reimburse the City for all costs and expenses, including without limitation, attorneys' fees, expert fees, consultant fees, court costs, and litigation or arbitration fees or expenses that the City has incurred.

GC-51.6 City's Right to Clean Up

If a dispute arises between Contractor and separate contractors as to their responsibility for cleaning up or for accomplishing coordination, the City may clean up and carry out such work and charge the cost thereof to Contractors responsible therefor as the Engineer shall determine to be just.

GC-52 OFFICIAL NOT TO BENEFIT

No officer or employee of the City shall be permitted to participate in the performance of this Agreement or receive any benefit or compensation arising out of the performance of such Agreement, and any Agreement entered into by the City in which any officer or employee of the City shall be personally interested shall be void, and no payment shall be made thereon by the City or any officer thereof; but this provision shall not be construed to extend to the Agreement if made with a corporation for its general benefit.

A bribe or attempt to bribe any representative or officer of City by Contractor shall be considered as a breach of the Agreement in bad faith, and shall thus empower City to complete Work and deduct the entire cost thereof from any monies due or to become due Contractor under the Agreement.

GC-53 GRATUITIES AND KICKBACKS

The Contractor's Contract may be terminated in accordance with the Clause titled "TERMINATION FOR DEFAULT" if, after notice and hearing, the City determines that the Contractor, its agent, or another representative offered or gave a gratuity or kick-back to an officer, official, or employee of the City and intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

The rights and remedies of the City provided in this Clause are not exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

The Contractor warrants that: (1) it has not employed nor retained any company or person, other than a bona fide employee working for the Contractor, to solicit or secure the contract; and that the Contractor has not paid or agreed to pay any person, company, association, corporation, individual or firm, other than a bona fide employee working for the Contractor, any fee, commission, percentage, gift or any other

consideration contingent upon or resulting from the award or making of the contract. After Notice and hearing and upon a finding in contradictions to this Paragraph constituting a breach or violation of the above warranty, the City has the right to terminate the contract or take other appropriate actions.

GC-54 PRECONSTRUCTION CONFERENCE

Within twenty (20) days after delivery of the executed agreement by City to Contractor, but before issuance of Notice to Proceed, a conference will be held to review progress schedules, to review the insurance and safety program, to establish procedures for handling Shop Drawings and other submittals and for processing progress payments, and to establish a Working understanding between the parties as to the Project.

Contractor shall submit to the City for approval, prior to the preconstruction conference, a preliminary schedule of Shop Drawing submittals, and certification of insurance as required by Appendix B.

GC-55 TIME OF COMPLETION AND LIQUIDATED DAMAGES

GC-55.1 Liquidated Damages

It is understood and agreed that the City will sustain substantial monetary and other injury and damages, including, but not limited to, increased costs, expenses and liabilities in the event of failure by Contractor to perform its Work in accordance with the Completion and any Interim Milestone Date(s) set forth in the CPM Schedule prepared in accordance with the Special Conditions. Accordingly, should Contractor not complete the Work, or any such portion thereof, within the date(s) required by the CPM Schedule initially approved by the Engineer, as they may be adjusted pursuant to the Agreement Documents, then charges shall be assessed against any money due or that may become due Contractor in accordance with the following schedule:

For Each day of delay in Substantial Completion of the entire Work: \$400/ day

For Each day of delay in Final Completion of the entire Work: \$400/ day

The amount of such charges is hereby agreed upon as fixed liquidated damages due the City after the expiration of the Agreement Date(s) for completion specified in the CPM Schedule for the Work or portions thereof. Contractor and its surety shall be liable for any liquidated damages in excess of the amount due Contractor on the Final Payment.

If the CPM Schedule projects an untimely completion with unexcused delay and the City in good faith believes that retainage will be insufficient to cover the City's damages, Contractor agrees that the City may withhold additional funds to assure the payment of the liquidated damages owed by Contractor.

GC-55.2 No Penalty

The fixed liquidated damages are not established as a penalty but are calculated and agreed upon in advance by the City and Contractor due to the uncertainty and impossibility of making a determination as to the actual direct, incidental and consequential damages which are incurred by the City as a result of the failure on the part of Contractor to complete the Work within the Agreement Time and completion date(s) specified in the Agreement Documents. Liquidated damages shall start in accordance with the above schedule upon notification to Contractor in writing that all apparent Agreement Time allowed to achieve the relevant completion date has been consumed. Liquidated Damages as they accrue will be deducted from periodic partial payments to the extent they are sufficient to cover the liquidated damages owing; provided that any excess liquidated damages owing over the periodic partial payment amount may be deducted from retainage. Such deduction shall be in addition to the retainage provided for in the Agreement Documents. The remaining amount of liquidated damages owing upon completion will be deducted from any amounts owing as Final Payment to Contractor or its surety. Any excess amount owing as liquidated damages shall be paid upon demand.

GC-56 RIGHT TO AUDIT

Contractor shall keep and maintain accurate books and records, and supporting data, documentation, correspondence, reports, instructions, Drawings, receipts, vouchers, and memoranda regarding performance of Work hereunder and including specifically, but without limitation, such information as estimates (pre and post Bid), costs incurred, labor and Materials consumed, schedules and progress records and quality control. Such books and records shall be available for inspection, audit, and copying by the City or its authorized representative for any purpose during the Work and for a period of three (3) years after Final Payment.

GC-57 DISPUTES

GC-57.1 Mediation

In the event of any controversy, claim, dispute or other matter in question arising out of or relating to this Agreement of the breach thereof or otherwise in connection with the Project to which this Agreement pertains, at the City's sole and exclusive option the parties shall, if the City so elects and as an express condition precedent to any party to this Agreement commencing legal action against the other relating to or arising out of the dispute, mediate the dispute utilizing a mutually agreeable mediator. Prior to commencing any legal action against the City, Contractor must either mediate the dispute, at the City's election, or obtain a written waiver from the City of its right to mediate.

GC-57.2 Arbitration at the City's Election

At the Owner's sole election, any Claim arising out of or related to the Agreement shall be subject either to binding arbitration or litigation at the City's option. Prior to arbitration or litigation, the parties shall endeavor to resolve Claims or disputes in accordance with the terms of this Contract.

GC-57.2.1

If Claims are not resolved by negotiation, mediation, or otherwise, and the Owner elects arbitration, the arbitration shall be held in Atlanta, Georgia and shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently then in effect or such other similar rules and organization as the Owner may elect. The demand for arbitration shall be in writing and filed with the appropriate organization selected by the Owner and shall be served on the other party to the Contract. The agreement to arbitrate shall be specifically enforceable under applicable law in any court having jurisdiction thereof. In any arbitration or litigation, the arbitrators or the Court shall have the jurisdiction to award the City costs, arbitrator fees, expert fees, and attorneys' fees, and the arbitrators or the Court shall award all such fees to the City if it is the prevailing party.

GC-57.2.2

Except at Owner's sole discretion and with its consent, no arbitration arising out of or relating to the Agreement shall include, by consolidation or joinder or in any other manner, any other person or entity, including but not limited to the Designer and its employees and consultants, any of Contractor's subcontractors and suppliers, and any other separate contractors or suppliers. The Owner's consent or election to allow consolidation or joinder or shall not constitute consent to arbitration of any claim not subject to arbitration pursuant to this Contract.

GC-57.2.3

Any award rendered by an arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

GC-57.3 Litigation If Arbitration Not Elected

If the Owner does not elect arbitration, any Claims shall be resolved in Fulton County, Georgia Superior Court. Contractor hereby submits to jurisdiction and venue in Fulton County, Georgia, and waives all defenses based on a lack of jurisdiction and/or venue. Contractor acknowledges that this Agreement was negotiated, at least in part, in Fulton County, Georgia. In any arbitration or litigation, the arbitrators or the Court shall have the jurisdiction to award the City costs, arbitrator fees, expert fees, and attorneys' fees, and the arbitrators or the Court shall award all such fees to the City if it is the prevailing party.

GC-58 AGREEMENT ADMINISTRATION DOCUMENTS

A substantial number of documents will be required for the administration of the Agreement. Some of these documents are identified in this document and elsewhere in the Agreement Documents (such as the Payment and Performance Bond forms) and others may not be. The Engineer shall have full power and authority to designate and prepare the documents to be used and Contractor and all Subcontractors and Material Suppliers shall utilize the documents so prepared and provided to them by the Engineer and shall follow the instructions of the Engineer with respect thereto in all regards save and excepting only those documents, if any, which Contractor reasonably determines contain terms or requirements contrary to or in addition to and not reasonably inferable from the terms of the Agreement Documents. If Contractor believes that any form or other document provided by the Engineer under the authority of this Section is subject to rejection by Contractor under the terms hereof, it shall notify the Engineer thereof within ten (10) days following its first receipt of the particular document or form giving specific reasons why the document or form is entitled to rejection. Thereafter, the form or document will be withdrawn, amended, or utilized as the Engineer finds in good faith to be appropriate after reviewing the notice provided by Contractor. All agreement administration documents may be revised at any time by the Engineer.

GC-59 MISCELLANEOUS PROVISIONS

GC-59.1 Governing Law

The Agreement shall be governed by the law of the State of Georgia.

GC-59.2 Contingent Assignment

Effective as of any termination of the Agreement, Contractor hereby assigns to City all of Contractor's interest in those subcontracts and purchase orders entered into by Contractor prior to termination if the City specifically requests such an assignment by Written Notice. All Subcontractors and Purchase Orders shall provide that they are freely assignable by Contractor to the City and its assigns. City shall be at liberty to negotiate with and engage (for itself) any Subcontractors, Suppliers, or others that Contractor dealt with prior to termination.

GC-59.3 Rights and Remedies

GC-59.3.1

The duties and obligations imposed by the Agreement Documents and the rights and remedies available there under shall be in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.

GC-59.3.2

No action or failure to act or to require in any one or more instances upon the strict performance of any one or more of the provisions of the Agreement Documents, or to exercise any right here in contained or provided by law by the

City or the Engineer, shall constitute a waiver of any right or duty afforded any of them under the Agreement Documents, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach hereunder, nor shall it be construed as a waiver of the right to subsequently demand strict performance or exercise such rights, and the rights shall continue unchanged and remain in full force and effect, except as may be specifically agreed in writing.

GC-59.3.3

Contractor agrees that it can be adequately compensated by money damages for any breach of this Agreement which may be committed by the City and hereby agrees that no default, act, or omission of the City, or the Engineer, shall constitute a material breach of the Agreement entitling Contractor to cancel or rescind the provisions of this Agreement or (unless the City shall so consent or direct in writing) to suspend or abandon performance of all or any part of the Work. Contractor hereby waives any and all rights and remedies to which it may otherwise be or become entitled, save only its right to money damages.

GC-59.4 Unenforceability of any Article

If any Article or term of the Agreement Documents is held as a matter of law to be unenforceable or unconscionable, the remainder of the Agreement shall be enforceable without such clause or term, and only the narrowest possible portion of the clause or term that is allowed by law shall be unenforceable.

GC-59.5 Obligation to Perform

Contractor shall carry on the Work and adhere to the approved current CPM Schedule during and notwithstanding all disputes or disagreements with City. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as Contractor and City may otherwise agree in writing.

GC-59.6 Labor Relations

Work on the Project may be performed by both union and nonunion separate contractors, Subcontractors, Suppliers, and other entities and persons. In the event of any strike, picket, sympathy strike, work stoppage, or other form of labor dispute at the Project whether directed at Contractor, other separate contractors, Subcontractors, Suppliers or other persons, Contractor shall continue to perform its Work required hereby without interruption or delay. In the event Contractor fails to continue its Work without interruption or delay, because of any or such events, the City, in addition to all other rights it has in the Agreement Documents and at law, may terminate the Agreement after giving Contractor forty-eight (48) hours written notice of its intent to do so for reason of Contractor's failure to perform. Additionally, if Contractor is party to one or more labor agreement, Contractor shall take all reasonable action to avoid any Work stoppage, and in the event of a work stoppage, Contractor shall within twenty-four (24) hours take all legal action permitted by such labor agreements or by law in order to expedite resumption of Work on this Project.

GC-59.7 Covenant Not to Sue

Should the City elect to terminate the employment of Contractor for default as provided herein, then Contractor covenants that it will not file any suit or proceeding of any kind against the City by reason thereof until the City shall have either abandoned the Project or completed the Work as defined under the Agreement Documents. If Contractor should breach this "Covenant Not To Sue," then Contractor shall be liable to the City for all costs resulting to the City therefrom, including, without limitation, all attorneys' fees expended by the City in defending said suit or proceeding, unless a positive determination is made therein that Contractor's termination by the City was motivated by fraud and bad faith and was without justification of any kind.

GC-59.8 Publicity and Advertising

The Contractor will not make any announcement, take any photographs, or release any information concerning the Work, this Contract, or the Project to any member of the public, press, business entity, or any official body, unless prior written consent is obtained from the City's Representative. The Contractor may not erect any signs without the written approval of the City's Representative.

GC-60 STATEMENT OF NON-DISCRIMINATION

During the performance of this Agreement, Contractor agrees to comply with all provisions of Part 2, Chapter 2, Article X, Division 11, including Section 2-1414 of the Code of Ordinances, City of Atlanta, as may be hereafter amended.

GC-61 EQUAL BUSINESS OPPORTUNITY (EBO)

During the performance of this Agreement, Contractor agrees to comply with all provisions of Part 2, Chapter 2, Article X, Division 11, including Section 2-1441 through 2-1460 of the Code of Ordinances of the City of Atlanta, the Equal Business Opportunity ("EBO") Program as may be hereafter amended.

GC-62 WAGE RATES AND REPORTING PROCEDURES

GC-62.1 Certified Payrolls

Contractor shall maintain accurate payroll records and be prepared to submit certified copies for the prime contractor and all subcontractors. Payrolls reporting an employee for the first time must contain the complete name, address, and social security of the employee.

GC-62.2 Submittals

All required payrolls shall be submitted to the Office of Contract Compliance. Any questions concerning these submittals can be addressed:

Office of Contract Compliance
55 Trinity Avenue, Suite 1700
Atlanta, Georgia 30303
(404) 330-6010

GC-62.3 [Intentionally Omitted]

PART III

SPECIAL CONDITIONS

PART III – SPECIAL CONDITIONS

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SPECIAL CONDITIONS

SC-1 PRECONSTRUCTION VIDEO SURVEY AND INSPECTIONS

Contractor is expressly advised that the protection of buildings, structures, equipment, electrical systems, instrumentation and related work adjacent and in the vicinity of its operations, wherever they may be, is solely its responsibility. Conditional inspection of buildings, structures, equipment, electrical systems and instrumentation shall be performed by and be the responsibility of the Contractor.

Repairs or replacement of all conditions disturbed by the construction shall be made to the satisfaction of the Engineer. This does not preclude conforming to the requirements of the insurance underwriters. Two (2) copies of surveys, photographs, videos, reports, etc., shall be given to the Engineer.

The Contractor shall retain an independent Consultant, specializing in preconstruction surveys, to conduct the required inspections. The preconstruction survey will be performed by a firm specializing in performing such surveys. The qualifications and experience of the proposed consultant shall be submitted to the Engineer for approval prior to assignment of the Services.

Perform a preconstruction video survey and inspection in advance of construction to document the existing condition of buildings, facilities, structures, utilities, roads, driveways and related work.

The video surveys and inspections shall clearly document the existing conditions and be completed before any operations have begun and subject areas disturbed by any construction activities. The video surveys and inspection notes, reports, etc. shall be submitted to the Engineer. The video surveys and inspections shall make an examination of the interior and exterior of buildings, structures, facilities and utilities, and record by notes, measurements, photographs, videos, etc., conditions which might be aggravated by construction activities. Prior to any type of blasting, video surveys and inspections of residences and other private structures existing within the survey and inspection corridor shall have been completed.

The cost of all pre-construction video surveys and inspections shall be borne by the Contractor.

SC-2 RIGHT OF WAY AND CONSTRUCTION ACCESS

The City will furnish all rights of way for the performance of Services included in this Agreement. Areas designated on the Agreement Drawings as the

Contractor's Work Area will be provided to the Contractor for the duration of construction, without charge. The Contractor will be responsible for observing the limits of the right-of-way and shall prohibit any Services being done on or any damage to property outside the bounds of the right-of-way. Additional work and storage space, if required, shall be obtained by the Contractor at no additional costs to the City.

SC-3 SAFETY AND HEALTH

The Contractor shall comply with all applicable health and safety standards and provisions required by the City of Atlanta, Fulton County, State of Georgia, and the Federal Government and its regulatory agencies. The Contractor shall maintain an accurate record of all cases of death, occupational diseases, and injury requiring medical attention or causing loss of time from work arising out of and in the course of employment on work under the Contract. This project involves work in and around operating combined and sanitary sewer systems. In these areas as well as in shafts and tunnels, the potential exists for toxic and/or explosive gases. The Contractor shall exercise caution when entering any confined space. The atmosphere shall be tested for oxygen levels, presence of chemicals, and explosivity before entry. Contractor alone shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods, and for any damage, which may result from their failure or their improper construction, maintenance, or operation.

- A. Emergency phone numbers (fire, medical, police) shall be posted at the Contractor's phone and its location known to all.
- B. Accidents shall be reported immediately to the Engineer by messenger or phone.
- C. All accidents shall be documented and a fully detailed written report submitted to the Engineer after each accident.
- D. A Confined Space Entry permit shall be completed each day along with any required atmospheric monitoring prior to anyone entering the tank and throughout each day when any personnel are in the tank. Each daily Confined Space Entry permit shall be retained and submitted to the City.

SC-4 LAYOUT OF THE WORK AND SURVEYING

SC-4.1 General

- A. The Services required include providing field engineering services, which includes establishing and maintaining survey control points and baselines as necessary to control the alignment (vertical and horizontal) and all parts of the Services within the specified tolerances, and documentation of the results.

- B. The Contractor shall be responsible for the development and implementation of a surveying program capable of satisfying all Project survey and accuracy requirements. This program shall be subject to the review of the Engineer before commencement of the work. The review shall in no way release the Contractor of liabilities associated with or dependent on this part of the Services.
- C. Control datum for the survey has been established by the Engineer and is indicated on the Drawings.

SC-4.2 Quality Control

- A. Planning and execution of the field engineering services shall be supervised by engineers or land surveyors registered in the State of Georgia and shall be conducted by personnel with documented experience in the specific types of work required.
- B. The allowable combined errors of land surveys shall be compatible with excavation, and pipe placement tolerances.

SC-4.3 Submittals Related to Contractor's Field Engineering Services

- A. Submit qualifications of land surveyor supervisor(s) with detailed references made to projects requiring application of similar surveying procedures and techniques including name, address, and telephone number to the Engineer for review prior to commencement of any survey work.
- B. Submit detailed description of proposed survey method, network diagrams and equipment type, accompanied with manufacturer's literature specifying probable accessories, calibration procedures, requirements and frequencies.
- C. Submit shop drawings showing survey monument materials and methods of installation, preservation and recovery.
- D. Submit mathematical pre-analysis to demonstrate that the required accuracies can be achieved using the proposed methods.
- E. Submit, upon request, a complete and accurate log of control and survey work including documentation verifying accuracy of survey work as it progresses, and upon completion of the Work. Documentation shall include, but not be limited to, survey field books, sketches, drawings and layouts.

SC-4.4 General Requirements Related to Contractor's Field Engineering Services

- A. Establish, verify and maintain a minimum of **three (3)** survey monuments for the work. The monuments shall be permanent on site and referenced to the established survey control points. Record locations, with horizontal and vertical data, on Project Record Documents. Monuments will also be

checked and verified by the construction verification surveyor. Survey notes relating to the monuments and primary control points shall be submitted to the Engineer.

- B. At all times, protect, preserve and maintain survey control points used for the Services. Report to the Engineer the loss, destruction or relocation of any survey control point and replace survey control points based on original survey control. Make no changes without prior written notice to the Engineer.
- C. Use equipment and implementation techniques such as forced centering techniques at survey control points as necessary to achieve required accuracies.
- D. Furnish information to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in, or affected by, construction. Through the Engineer, coordinate with local authorities having jurisdiction.
- E. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Foundation and wall locations, sloping floor elevations, and embedment centerlines and elevations.
- G. Where the dimensions and locations of existing structures are of critical importance in the installation or connection of any part of the work, verify such dimensions and locations in the field before the fabrication of any material or embedment, which is dependent on the correctness of such information.

SC-4.5 Calibration and Data Processing

- A. Calibrate all procedures and instruments as required and as recommended by the instrument manufacturer. Maintain a log showing date and type of calibration performed indicating the name of the individual performing the calibration.
- B. Data reduction shall incorporate calibrations and meteorological corrections, and rigorous reduction of measurements to the ellipsoid and thence to the coordinate system. Correct distance measurements by electro-optical distance measurement instrument for scale, cyclic error, zero error, and meteorological effects. Correct azimuths using the Laplace correction and include the effect of the deflection of the vertical components on angles and azimuth measurements.

- C. Data processing shall include, as required, rigorous least squares adjustments. Employ data outlier detection. Determine horizontal and vertical confidence intervals.

SC-5 DISPOSAL OF WASTE MATERIAL

The disposal of all excavated material or spoil not required for use in the permanent work shall be the responsibility of the Contractor. He shall remove all excess excavated material or spoil from the site of the Work and dispose of the same in a legal manner at no additional cost to the City. Burning of debris on site will not be allowed.

SC-6 REMOVAL OF CONDEMNED MATERIAL

Material on the site, which has been determined by the Engineer to be unsuitable or not in conformity with the Contract documents shall be removed from the vicinity of the work without delay and disposed of in an approved area.

If the Contractor fails to do so within forty-eight (48) hours after the receipt of notice, the condemned materials may be removed by the City and the cost of said removal shall be borne by the Contractor.

SC-7 DETECTION OF MOVEMENT

In order to detect any movement of buildings or structures that may be affected by his work, Contractor shall, prior to excavation, establish a system of vertical and horizontal control points on or about such buildings or structures, tied to bench marks and indices sufficiently remote to not be moved by his operations. A plan of this system shall be submitted to the Engineer for review. Reading shall be taken of these points and permanently recorded prior to the start of excavation. The City will not assume any responsibility for alleged damages to any building or structure arising from the Services performed under this Agreement.

SC-8 EXISTING UTILITIES

SC-8.1 Verification of the Location of the Existing Utilities

Representations of existing utilities, facilities, and structures in the Contract Documents are based upon the best available information. The City and the Engineer will not be responsible for the completeness or accuracy thereof nor for any deductions, interpretations, or conclusions drawn therefrom. The Contractor shall verify to his own satisfaction by test pit or other means, the actual location of existing utilities prior to construction in their vicinity.

- A. Should the Contractor in the course of his operations encounter any underground utilities the presence of which was not previously known, or a different type than shown, he shall immediately notify the Engineer and take all necessary precautions to protect the utility and maintain continuance of service until said utilities can be adjusted by the appropriate owners.
- B. Contractor will notify all public utility corporations, jurisdictional agencies, or other owners to make all necessary adjustments to public utility fixtures and appurtenances within or adjacent to the limits of construction. Delays and additional cost resulting from a failure of the Contractor to notify the utility or to provide adequate notice to the utility shall be at no additional cost to the City, when such facilities are indicated in the Agreement Documents, and in such case, no extension of time will be granted for delays caused by utility adjustments.
- C. Damage caused to utilities either directly or indirectly by the Contractor shall be repaired and the facilities restored to their original condition to the satisfaction of the Engineer and the utility owner, at no additional cost to the City.

SC-8.2 Work in Vicinity of Existing Utilities

At least three (3) working days prior to starting work in the vicinity of utility structures and appurtenances, Contractor shall notify Engineer and appropriate utility companies and jurisdictional agencies. Contractor shall support and protect all utility structures and appurtenances in accordance with the requirements of the Agreement Documents and the utility companies, and shall take any other steps necessary to protect the structures from disturbance or damage.

A substitute City of Atlanta Ordinance adopted March 13, 1978 requires Contractors to contact each gas company maintaining underground gas pipes or facilities within the city limits prior to the start of excavation work by blasting or mechanized excavating equipment.

SC-8.3 Access to Utilities Facilities

The Contractor shall at all times permit free and clear access to the various affected facilities by personnel of the utility owners or operators who are working within the limits of work for the purpose of inspection, maintenance, or providing additional service requirements, and the construction of new facilities. When personnel of the utility owners or operators are working within the limits of work to be performed by Contractor, the Contractor will not be relieved of his responsibility for the maintenance and protection of such facilities.

SC-9 WORK IN FLOOD PLAIN AREAS

The Contractor shall comply with all regulations of Section 16-26006 of the Zoning Ordinance of the City of Atlanta concerning work in Flood Hazard Districts, and Fulton County Zoning Resolutions regarding Flood Protection.

SC-10 MAINTENANCE OF TRAFFIC

Contractor shall provide, erect, maintain, and finally remove all barricades, danger warning and detour signs necessary to properly protect and divert traffic. All barricades and signs, including detour signs, shall be illuminated at night or when visibility is reduced. The Contractor will be held responsible for all damage to the Services due to failure of the signs and barricades to properly protect the Services from traffic, pedestrians, animals, and from all other sources, and whenever evidence of any such traffic is found upon the Services the Engineer will order that the Work, if in his opinion it is damaged, be immediately removed and replaced by the Contractor at no additional cost to the City. The devices used will be in accordance with the manual of Uniform Traffic Control Devices for Streets and Highways compiled by the State Department of Transportation. Access to City streets and roads will be limited and will require the use of flagmen or the installation of traffic control signals, or both. The City must approve haul routes.

A City of Atlanta Substitute Ordinance adopted March 13, 1978 requires that Contractors obtain a permit for work involving blockage of a public street. Open pits, trenches, unpaved streets, debris, or other obstructions due to construction that will prevent the normal flow of traffic during an extended construction stoppage for any reason, will not be permitted. In the event an extended construction stoppage is found to be necessary, Contractor shall, at his own expense, provide normal traffic flow during extended construction stoppage. Extended stoppage will be defined by the City.

SC-11 ENVIRONMENTAL PROTECTION

SC-11.1 General

Contractor shall conduct his operation in a manner to prevent pollution of the environment surrounding the area of work by every means possible and shall be responsible for furnishing all necessary items for fulfilling the work described herein.

SC-11.2 Material Transport

Contractor shall comply with Section 11-2021 of the Code of Ordinances of the City of Atlanta pertaining to the duties of the Contractor in hauling material over City owned rights-of-way. This includes but is not limited to, approval of proposed haul routes, prevention of dropping of materials or debris on the streets from

trucks arriving and leaving the site, providing a suitable vehicle inspection and cleaning installation with permanent crew, and the removal of any material spilled in public areas at no additional cost to the local government agency.

SC-11.3 Waste Materials

No waste or erosion materials shall be allowed to enter natural or manmade water or sewage removal systems. Erosion materials from excavations, borrow areas, or stockpiled fill shall be contained within the work area. Contractor shall develop methods for control of waste and erosion, which shall include such means as filtration, settlement, and manual removal to satisfy the above requirements.

SC-11.4 Burning

No burning of waste shall be allowed.

SC-11.5: Dust Control

The Contractor shall at all times control the generation of dust by his operations. Control of dust shall be accomplished by water sprinkling or by other methods approved by the Engineer.

SC-11.6 Noise Control

The Contractor shall take every action possible to minimize the noise caused by his operation.

When required by agencies having jurisdiction, noise-producing work shall be performed in less sensitive hours of the day or week as directed by the Engineer.

The Contractor shall provide equipment that operates with the least possible noise. The use of noisy equipment is prohibited. Hoists and compressor plants shall be electrically operated unless otherwise permitted. The air intake of compressors shall be equipped with silencers, and machinery operated by gearing shall be provided with a type of gearing designed to reduce noise to a minimum. Internal combustion engines shall be equipped with mufflers in good order.

Noise generated by mobile construction equipment, stationary construction equipment, and other equipment involved in the construction of the work shall not exceed the decibel levels indicated below. Noise generated by mobile and stationary construction equipment will be measured three to 6 feet from building lines, and on the A weighing network of Type-2 general purpose sound level meter set at fast response.

	Combined Residential and Commercial
Allowable Sound Levels of Mobile Construction Equipment: - From 7 a.m. to 10 p.m., Monday thru Saturday, Except Legal Holidays - At times other than those listed above	85 dBA 70 dBA
Allowable Sound Levels of Stationary Construction Equipment: - From 7 a.m. to 10 p.m., Monday thru Saturday, Except Legal Holidays - At times other than those noted above	70 dBA 60 dBA

Contractor shall assure compliance by measuring noise levels as may be required.

SC-11.7 Use of Chemicals

All Chemicals used during construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either EPA or FDA. Use of all such chemicals and disposal of residues shall be in conformance with instructions.

SC-11.8 By-Passing During Construction

No wastewater shall be by-passed at sewage collection or treatment facilities during project construction unless a by-passing schedule has been approved by City and the Georgia Environmental Protection Division. It shall be the responsibility of the Contractor to prepare and secure the approval of any by-passing not specifically identified in the Agreement Documents.

SC-11.9 Responsibility for Spills and Accidental Discharges

In the event that the Contractor causes or has a spill or accidental discharge for which the City is fined by the State of Georgia EPD, the Contractor agrees to remediate the spill or discharge immediately in accordance with current EPD regulations and to pay any fines assessed against the City and/or Contractor, and pay for the City's cost associated with efforts to remediate the situation.

SC-12 RIGHT TO OPERATE

As soon as any portion of structures and equipment are ready for use, the City shall have the right to operate such portion upon written notice to the Contractor by the City. The City shall also issue a certificate of completion for that portion of the work. Guarantee period on that portion of Service will begin upon issuance of certificate of completion for that portion.

Testing of equipment and appurtenance and training of City's personnel as specified hereinunder shall not constitute operation.

The execution of the bonds shall constitute the consent of the surety.

The Contractor shall provide an endorsement to his insurance permitting occupancy of the structures and use of equipment during the remaining period of construction.

SC-13 LIST OF MATERIALS, FIXTURES AND EQUIPMENT

- A. Within thirty (30) days after issuance of the Notice to Proceed, before any materials, fixtures or equipment are purchased, and prior to start of construction, the Contractor shall submit for approval by the Engineer the names and addresses of the manufacturers, and their catalog numbers and trade names for all materials, equipment and fixtures listed under the following Sections of the Agreement Documents:

Divisions 2, 3, 5, 7, 8, 9, 11, 12, 13, 15 and 16

The Contractor shall furnish other detailed information when so directed, under the various items. No consideration will be given to partial lists submitted from time to time except that approval of long delivery items of equipment may be requested individually. Items which are not in accordance with the Specification requirements may be rejected. The Contractor shall furnish a statement giving a complete description of all points wherein the equipment he proposes to furnish does not comply with the Specifications as well as any exceptions he may take to the Specifications. Failure to furnish such statements will be interpreted to mean that the equipment meets all requirements of the Specifications.

- B. In the event the Contractor wishes to resubmit items of materials, fixtures and equipment for review subsequent to obtaining approval as indicated in "A" above, then the Contractor shall pay the cost of the Engineering review of each such resubmittal including shop drawing review if this review has been performed.

SC-14 CITY OF ATLANTA PROJECT SIGN

The basic design of the Project sign shall conform ***to Attachment 1 herein*** including the names of all current Council Members, the Mayor and the Commissioner, Department of Watershed Management. The City seal portion of the sign must be shaded, such that it is visible from fifty (50) yards. A full color shop drawing submittal is required before fabrication. The Project sign will be no

less than 4'-0" x 8'-0" and the City requires a Project sign at the designated entrance to the Project.

In addition to the Project sign, there is to be adequate temporary signage for identifying the Project areas, offices, delivery areas and any other designations the Engineer and/or the Contractor feel are needed. These signs will designate which Phase of the Agreement that they pertain to as part of the Project coordination.

SC-15 PROJECT MEETINGS

The Engineer shall schedule weekly progress meetings. The progress meetings will be held at least weekly and may be scheduled at a more frequent interval by the Engineer if necessary. Progress meetings shall be held at a location designated by the Engineer.

Progress meetings shall be attended by the Engineer, Contractor, Subcontractors as appropriate to the agenda, suppliers as appropriate to the agenda and others as required.

The meeting agenda shall generally include review and approval of minutes of previous meeting, review of work progress since previous meeting, field observations, problems, and conflicts, problems which impede Construction Schedule, review of off-site fabrication and delivery schedules, corrective measures and procedures to regain project schedule, revisions to Construction Schedule, progress and schedule of the preceding work period, coordination of schedules, review of submittal schedules and status, status of requests for information, maintenance of quality standards, pending changes and substitutions, and other business.

SC-16 CONSTRUCTION SCHEDULE

Timely performance is of the essence on this Project. The Contractor may complete the Project or any part of the Project earlier than is stipulated in the Contract and the Milestone requirements. The Contractor may schedule his work to complete earlier than required by the Contract or stipulated in the approved schedule, however, under no circumstances shall the Contractor be entitled to added compensation for delays, which occur during the originally stipulated contract period.

The City has purchased the entire scheduled time period by virtue of this Contract and further stipulates that only those delays which meet the tests set forth in GC-26 will be considered for adjustment and only to the extent that they delay the work past the originally contractually stipulated milestones.

SC-16.1 Procedures

- A. The Work under this Contract shall be planned, scheduled, executed, reported and accomplished using the Precedence Diagramming Critical Path Method (hereinafter referred to as CPM). The work required by this section includes the requirement to prepare, maintain, and update all detailed schedules as described in this section. The CPM Schedules shall be prepared in such a manner as to permit the orderly planning, organization, and execution of the Work and be sufficiently detailed to accurately depict all the Work required by the Contract. Contractor shall resource (labor, material and equipment) and cost load its Schedule as specified herein.
- B. Contractor hereby agrees that in the process of preparing its baseline schedule and monthly updates, it will consult with all key Subcontractors and suppliers to assure concurrence with the feasibility and achievability of Contractor's planned start dates, sequencing, durations, and completion dates. A copy of the computer input files, XER format shall be submitted on CD-R with each submittal. The procedures, technical details and Contractor's participation and responsibilities shall be as hereinafter described.
- C. Contractor is responsible for determining the sequence of activities, the time estimates for the detailed construction activities and the means, methods, techniques and procedures to be employed. The Schedules identified herein shall represent the Contractor's best judgment of how it will prosecute the Work in compliance with the Contract requirements. Contractor shall ensure that the Schedule is current and accurate and is properly and timely monitored, updated and revised as Project conditions may require and as required by the Contract Documents.
- D. Contractor's construction schedule shall be prepared using the latest version of Primavera Project Planner (P6) for Windows. Any and all costs incurred by the CONTRACTOR in researching, training and/or educating its personnel in CPM and/or P6 (or the utilization of outside consultants) shall be part of the Contractor's bid price and not reimbursed separately by the City
 - 1. The Project Network Schedule Diagram, mathematical analysis, written narrative and monthly updates will be reviewed by either the Engineer or an independent consultant selected by the Engineer. Items will be reviewed for compliance with these Specifications and accurate reporting by the Contractor of work in place, resource loading and work activity durations.
 - 2. Submit to the Engineer an accepted final CPM Construction Schedule and Final Schedule of Values including Allowance Items, allocated to the CPM Schedule activities within 45 days of the Notice to Proceed. Requirements for the final CPM Construction and Final Schedule of Values are further described hereinafter.

Contractor's Application for Payment will not be approved until the final CPM Schedule and Schedule of Values have been accepted. The Contract Baseline Schedule submittal shall not show any progress until it is accepted by Engineer

SC-16.2 Standards

- A. Definition: CPM, as required by this Section, shall comply with the standards outlined in the Associated General Contractors' publication, "Construction Planning and Scheduling" unless specifically changed by this Section.
- B. CPM Construction Schedule: The Contractor's CPM Construction Schedule shall include a graphic time scaled logic network, computerized tabular reports and resource loading as described below. To be acceptable, the schedule must demonstrate the following:
 - 1. A logical succession of Work from start to finish. This logical succession, when accepted, is the Contractor's work plan and, contrary to normal CPM standards, is designated as early start/early finish solely to accommodate the Primavera software.
 - 2. Clear definition of each activity including cost, manpower, equipment and material quantities as resources. The assigned dollar value (cost loading) of each activity shall cumulatively equal the contract price.
 - 3. Proper interfacing of related activities including submittals, major material and equipment deliveries, procurement, required permits and other constraints such as equipment or manpower/crew availability. Submittal dates must include review periods and permit schedules must include agency review and issue dates. The narrative shall explain the rationale for all constraints, lags and unusual relationships.
 - 4. Agreement with the interim milestones, schedule coordination requirements, and completion dates indicated in the Contract Documents.
- C. CPM Graphic Logic Network
 - 1. The CPM graphic logic network or diagram shall be in the form of a time-scaled diagram of the customary precedence diagram and may be divided into a number of separate pages with suitable notation relating the interface points among the pages. Individual pages shall not exceed 34-inch by 44-inch. Notation on each activity line shall include activity descriptions, total float, and durations as a minimum.
 - 2. All construction activities and procurement shall be indicated in a time-scaled format, and a calendar shall be shown on all sheets along the entire sheet length. Each activity shall be plotted so the

beginning and completion dates of said activity can be determined graphically by comparison with the calendar scale. A legend shall be included clearly distinguishing between critical and non-critical path activities and progress to date.

- D. Duration: The duration indicated for each activity shall be in units of whole working days and shall represent the single best time considering the scope of the Work and resources planned for the activity including time for holidays and inclement weather. The calendar for the network shall be in calendar days. Except for certain non-labor activities, such as submittal preparation and review, curing concrete, delivering and fabrication of materials, or other activities described specifically in the Contract, activity durations shall not exceed 14 Days, be less than one Day, nor exceed \$50,000 in value unless otherwise accepted by the Engineer.
- E. For all equipment and materials to be fabricated or supplied for the Project, the Contract Baseline Schedule shall show a sequence of activities including: (a) preparation of shop drawings and sample submissions; (b) thirty (30) calendar days for review of shop drawings and samples (c) shop fabrication, delivery and storage, (d) erection or installation; and, (e) testing of equipment and materials.
- F. The Interim Schedule and Contract Baseline Schedule shall show dependencies (or relationships) between each activity. Each activity must have a successor and predecessor, except for the Project Start and Finish Milestone. The use of date constraints shall be limited to Contract Milestones and Contract Completion dates only, unless approved by the Engineer.
- G. Contract Baseline Schedule shall contain or be able to demonstrate that the following items have been addressed: (a) the Project's name; (b) the Contractor's name; (c) revision or edition number; (d) activities of completed work, (e) activities relating to different areas of responsibility, such as subcontracted Work which is distinctly separated from that being done by the Contractor directly; (f) labor resources distinguished by craft or crew requirements; (g) equipment and material resources distinguished by equipment and material requirements; (h) distinct and identifiable subdivisions of work such as structural slabs, beams, columns; (i) locations of work within the contract limit lines that necessitates different times or crews to perform; (j) outage schedules for existing utility services that will be interrupted during the performance of the Work; (k) acquisition and installation of equipment and materials supplied and/or installed by the Owner or its separate contractors; (l) material to be stored on site; (m) Phases; and (n) Interim Milestones and the Contract Completion dates.
- H. Computerized Tabular Reports: Reports shall include the following for each activity depicted in the schedule.
 - 1. Activity ID
 - 2. Activity Description

3. Duration (original and remaining)
 4. Early Start Date
 5. Early Finish Date
 6. Total Float
 7. Percent Complete
 8. Activity Cost and Resources
 9. Actual Start Date
 10. Actual Finish Date
- I. Project Information: Each report shall be prefaced with the following summary data.
1. Project Name
 2. Contractor
 3. Type of Tabulation (Initial or Updated)
 4. Project Duration
 5. Project Scheduled Completion Date
 6. Projected Completion Date
- J. The Contract Baseline Schedule shall include coding (both activity and project coding) to allow additional grouping and sorting means. The Engineer shall provide the coding dictionary. Coding shall include (but shall not be limited to) the following:
1. Area
 2. **Department**
 3. **Phase**
 4. **CSI Code**
 5. Responsibility
 6. Crew/ Craft

SC-16.3 Acceptance

- A. The finalized CPM Construction Schedule will be acceptable to the Engineer when it provides an orderly progression of the Work from Notice to Proceed to Final Completion in accordance with the Contract requirements, adequately defines the Contractor's Work plan, provides a workable arrangement for processing submittals in accordance with the requirements, and properly allocates resource values for manpower, major materials, equipment and costs to each activity (free of unbalances in resources) as determined by the Engineer. Manpower may be represented as composite crews in the CPM Construction Schedule. The network diagram and tabular reports when accepted by the Engineer shall constitute the CPM Construction Schedule until revised and re-accepted.

- B. When the CPM Construction Schedule has been accepted, the Contractor shall submit to the Engineer:
 - 1. six (6) copies of the CPM graphic logic network,
 - 2. six (6) copies of a computerized, tabular report in which activities have been sequenced by early starting date,
 - 3. two (2) copies of the schedule on CD
 - 4. six (6) copies of the narrative..
- C. The Engineer's review and acceptance of the Contractor's CPM Construction Schedule is for conformance to the requirements of the Contract Documents only. Review and acceptance by the Engineer of the Contractor's CPM Construction Schedule does not relieve the Contractor of any of its responsibility whatsoever for the accuracy or feasibility of the CPM Construction Schedule, or of the Contractor's ability to meet interim milestone dates and the Contract completion date, nor does such review and acceptance expressly or impliedly warrant, acknowledge, or admit the reasonableness of the logic, durations, and resource value loading of the Contractor's CPM Construction Schedule.
- D. The Contractor shall participate in a conference with the Engineer to review the Engineer's comments on the schedule and evaluation of the proposed network diagram, mathematical analysis and monetary value of activities. The intent is to reach a clearer understanding of the CPM and reach consensus on any revisions to be made. Any revisions necessary as a result of this review shall be resubmitted to the Engineer within 10 calendar days after the conference. The accepted schedule shall then be used by the Contractor for planning, organizing and directing the work and for reporting progress. If the Contractor desires to make changes in his method of performing the Work, he shall notify the Engineer in writing stating the reason for the changes and receive written acceptance of the change prior to putting the change into the accepted schedule.

SC-16.4 Qualifications

- A. The Contractor shall demonstrate competence in the use of CPM scheduling through the submission of a fully compliant CPM Construction Schedule with the initial CPM submission. In the event the Contractor fails to so demonstrate competence in the CPM scheduling, the Engineer may direct the Contractor to employ the services of a Scheduling Firm that can demonstrate competence. The Contractor shall comply with such directive.
- B. The Contractor shall use the services of scheduler who has verifiable training and credentials in preparing and maintaining a computerized CPM Construction Schedule using Primavera software as specified herein. The scheduler must qualify within the planning period.
 - 1. Required Experience: Performed CPM scheduling on at least 2 completed construction projects of value at least 75 percent as

large as this one and having at least 75 percent as many schedule items as this one. Scheduling of both projects shall have been done using Primavera software (P6 for Windows) or equal.

2. Submit the following:
 - a. Descriptions of at least 2 projects of the value and complexity above.
 - b. Copy of a CPM schedule from one of the previous projects.
 - c. Names and telephone numbers of facility owner representative, design engineer, and construction manager for each project.
 - d. Evidence supporting the above qualifications shall be submitted to the Engineer.

SC-16.5 Submittal Requirements

- A. Initial submittal, revisions and monthly updates of the network diagram, mathematical analysis, and written narrative shall be submitted in six hard copies and two data copies on CD. Submittals will not be accepted unless they are complete as described herein.
- B. The Contractor shall submit the following:
 1. A CPM timescaled logic network, (computer generated).
 2. Computerized Tabular Reports.
 - a. Activity sort by early start, organized by facility or area.
 - b. Predecessor/successor listing.
 - c. Activity code dictionary.
 - d. Resource code dictionary.
 3. Basis of schedule narrative describing the logic and reasoning of the schedule. The narrative shall summarize the overall approach to construction sequencing, including but not limited to 1) anticipated lost days due to weather. 2) the rationale for all constraints, lags and unusual relationships. 3) the definition of labor and crews. 4) a list and durations for all major pieces of equipment and resources, and 5) work proposed to be performed on a other than single shift 5 day workweek basis
 4. Resource value allocation by activity.
 5. Breakdown of specific cost amount for each component of multi-component activities in the CPM Schedule in spreadsheet format (using Microsoft Excel) showing component unit quantities as well as costs. Such breakdown, when accepted by the Engineer shall constitute the Schedule of Values for the Project.
 6. CD copy of entire schedule, narrative and spreadsheet.

SC-16.6 SCHEDULE ORIENTATION SESSION

- A. Contractor shall, upon notification from the Engineer, attend a Schedule Orientation Session relating to the Schedules and Reports requirements for this Contract. The Schedule Orientation Session is designed to review in detail, the objectives of the Schedules and Reports requirements and the requirements. Contractor shall arrange for its Project Manager, Superintendent, and Scheduler to attend the Schedule Orientation Session.
- B. The following items shall be discussed during the Schedule Orientation Session: (a) The procedures and requirements for the preparation of the Contract Baseline Schedule, and monthly updates by Contractor. (b) how the requirements of the Contract Documents will be monitored and enforced by the Engineer. (c) long-lead items and time requirements for the Work by Subcontractors will be identified and included in the Contract Baseline Schedule. (d) testing and startup. (e) coding and logic for the Contract Baseline Schedule, and (f) identification and scheduling of shop drawings and other submittals.

SC-16.7 Schedule of Values

- A. Submittals
 - 1. Contractor shall allocate a dollar value for each activity on the Contract Baseline Schedule. The dollar value for the activity shall be the cost of the Work including labor, materials and equipment. Allowances shall be loaded on activities specifically included for this purpose. No activity on the Contract Baseline Schedule shall exceed a value of \$50,000, unless approved by the Engineer. The sum of all activity costs shall equal the Contract Price. Contractor shall revise the resource and value loading as necessary to gain the acceptance of the Engineer
 - 2. The Final Schedule of Values shall incorporate all comments associated with the Contractor's Schedule/Schedule of Values submittals.
 - 3. Submit documentation to support the values with data, which will substantiate their correctness, as requested by the Engineer.
 - 4. The Schedule of Values, when accepted by the Engineer, shall be used as the only basis for the Contractor's Applications for Payment. The total price paid for mobilization shall be as approved by the Engineer, but in no case shall it exceed two per-cent (2%) of the total bid amount and shall be substantiated with invoices and other backup documentation.
 - 5. The Schedule of Values shall be derived from the assigned Progress Schedule Activity Values and identified by Activity ID.
- B. Form and Content of Schedule of Values

1. Identify the Schedule of Values submittal with:
 - a. Title of Contract and location.
 - b. Contract Number.
 - c. Name and address of Contractor.
 - d. Date of submission.
 2. The Contractor's Schedule of Values shall list the installed value of the component parts of the Work in sufficient detail to serve as the basis for computing values for progress payments during construction.
 3. Identify accounts with the location code and area code as defined in the Primavera Schedule format and list the number and title of the respective major Section of the Specifications.
 4. All accounts in the Schedule of Values shall be derived from the activities in the Progress Schedule. Account data pertaining to the Schedule of Values shall, at a minimum, include the following for each Account:
 - a. CPM Activity number.
 - b. City of Atlanta Standard Code listed on the Bid Schedule.
 - c. Account representative quantities (cubic yards of concrete, tons of steel, etc.), unit costs, person-hours, item and account dollar value.
 - d. WBS code (as used Primavera Project Planner scheduling software), including location, responsibility and area codes.
 - e. CSI Specification Section Number.
 - f. Account Type: Lump Sum (LS), Unit Price (UP), Allowance (AL), or Change Order (CO)
 5. The Schedule of Values must be developed separately from the baseline schedule in a tabular electronic format (i.e. a Microsoft Excel Spreadsheet). Upon approval of the Schedule of Values and the Project Baseline Schedule, the Schedule of Values will be merged with the Project Baseline Schedule in P6.
- C. Lump Sum Accounts (LS):
1. The Lump Sum Items established in the Contractor's Bid shall be further divided into pay and progress items by the Contractor and submitted to the Engineer for approval, and as specified in Paragraph E.1 above. Payment for Lump Sum (LS) Accounts will be based upon physical progress (percent complete) for each related activity in the Progress Schedule.
 2. The dollar value allocated to Lump Sum Accounts shall be representative of the Contractor's actual costs for performing the work including overhead and profit, and shall be balanced to ensure that sufficient funds are allocated for each portion of the work and shall be subject to acceptance by the Engineer.

3. In the event account values can not be agreed to between the Engineer and the Contractor, the Engineer shall have the exclusive right to determine the account dollar amounts contained in the Schedule of Values.
 4. Mobilization costs shall be specifically identified in the Schedule of Values. All mobilization sub-accounts contained in the Schedule of Values must have a corresponding CPM Schedule activity. Payments for mobilization sub-accounts will be based upon lump sum (LS) values as accepted by the Engineer.
- D. Unit Price Accounts (UP): Payment for Unit Price Accounts shall be based upon actual quantities of Work performed in compliance with the Contract Documents, as verified and accepted by the Engineer. Whenever the actual quantity differs from the estimated quantity on the Unit Price Accounts, the Contractor shall notify the Engineer in writing. Quantity overruns and under runs will be tracked on the Schedule of Values.
- E. Allowance Accounts (AL): Payment for Allowance Accounts will be based upon invoices submitted by the Contractor subject to conditions and limitations of the Contract Documents. Refer to Section 01200, Measurement and Payment, for requirements. The Allowance shall be adjusted to the actual amount paid for such services, and adjusted by Change Order either at the end of that phase of the Work or at the completion of the Work. The City will have sole discretion on determining when to make adjustments to the Allowance.
- F. Cost of materials shall be assigned to the appropriate item of work, and allocated to a materials Sub-account. All materials items contained in the Schedule of Values must have a corresponding CPM Schedule activity, for various portions of the Work:
1. Except for Allowance Accounts identified in Section 01200, each account shall include a directly proportional amount of the Contractor's overhead and profit.
 2. For accounts on which progress payments will be requested for materials suitably stored on site, break down the value into:
 - a. The cost of each material delivered and unloaded.
 - b. Paid invoices will be required for materials.
- G. The Contractor shall include in his Schedule of Values items for site maintenance, and compliance with the terms of permit stipulations, as appropriate. These items will be monitored on a monthly basis. Non-compliance will result in monies being deducted from the appropriate items.
- H. A new account will be added to the Schedule of Values for approved Change Order work. Payment for Time and Expense Change Order work (CO) shall be based upon the General and Supplementary Conditions of these Specifications.

- I. The sum of all Account Values listed in the Schedule of Values shall equal the total Contract Price, excluding Allowance Items.

16.7.1 Sub-Accounts

- A. Include a breakdown of major accounts into sub-accounts on which progress payments will be requested. The sub-account breakdown shall include elements for pay items/progress items as appropriate, and show the weight of each sub-account; e.g., fabrication, installation, etc., with the total weight of the sub-accounts equal to 100 percent of the major account.
- B. The form of the submittal shall be consistent with the Schedule of Values, with each account identified the same as the line item in the Schedule of Values.
- C. The Contractor's Schedule of Values shall list the delivered value of the products, manuals and services provided under the various Specification Sections. The lists shall be sufficiently detailed to serve as a basis for computing values for progress payments during the construction period.
- D. The unit quantity for bulk materials shall include an allowance for waste.
- E. The unit values for the materials shall be broken down into:
 - 1. Cost of the material delivered and unloaded at the site.
 - 2. Copies of paid invoices for component material shall be included with the payment request in which the material first appears.
- F. The installed unit value multiplied by the quantity listed shall equal the cost of that account in the Schedule of Values.
- G. Quantities and unit values identified in the Component Materials sub-accounts shall be used for determining progress payments only, and are not considered to be unit price pay items.

SC-16.8 Monthly Application for Payment

- A. Monthly Application for Payment: Contractor shall provide monthly Schedule Update, monthly Payment Report and monthly Narrative Report as his monthly Application for Payment package. Failure to submit all of the aforementioned submittals will result in the cessation of the pay application process until all documents are received.
- B. Monthly Schedule Update: The Contractor shall submit, at intervals of 30 calendar days, an update of all activities in the as-planned CPM schedule. The Period-Ending Date shall be the 25th of each month. Update shall be created by updating the mathematical analysis and the corresponding computerized network diagram of the Schedule.
 - 1. The schedule shall be updated by entering the following: Actual start and completion dates of completed activities and the actual start date and remaining duration of activities in progress.

2. The updated network diagram shall be submitted in the same format as noted in Specification Section SC-16.1, with the calendar starting from the date of the update.
 3. The updated mathematical analysis shall be submitted in the same format noted in Specification Section SC-16.1.
 4. The schedule update shall include an update of the cash flow projections in the same format as the original approved submittal.
 5. The schedule update will state the percentage of the work actually completed and scheduled as of the report date.
- C. The Monthly Payment Report shall show the activities or portions of activities completed during the reporting period, their total monetary values and the monetary values earned as a basis for the Contractor's Application for Payment. A mutually agreed upon percent complete will be assigned to each completed and partially completed activity to be used for calculating the monetary value earned to date. For activities underway, the percent complete shall not be related to the remaining duration.
- D. A monthly narrative report shall be submitted including, but not limited to the following:
1. Description of work accomplished.
 2. Summary of safety and quality issues occurring during the month and corrective actions taken.
 3. Contractor evaluation of actual progress versus progress planned.
 4. If the project is behind schedule, progress along all paths with negative float shall be reported along with the reasons for the delay.
 5. A description of all revisions made to the schedule including: all accepted added, deleted, and revised activities; all logic revisions; and all duration revisions.
 6. A description of the problem areas, current and anticipated delaying factors and their impact, and an explanation of corrective actions taken or proposed.
- E. If the Contractor fails to submit any of the required components of the Application for Payment, the Engineer will withhold approval of the Application for Payment until such time as the Contractor submits the required components.

SC-16.9 Progress Meetings and Look-Ahead Schedules

- A. For the weekly progress meetings, the Contractor shall submit a four week Look-Ahead Schedule. This schedule will cover four weeks: the immediate past week, the current week, and the forthcoming two weeks. This schedule will include all activities which are complete, started, are incomplete or underway, or scheduled to be worked during this four week time frame. This schedule shall list all activities from the accepted CPM Construction Schedule which are complete, are scheduled for Work during

the period, are currently planned to be worked, even if out of sequence, and Work which is unfinished but scheduled to be finished. Actual start and completion dates shall be provided for the Work that has been completed the prior week; forecast start and finish dates shall be provided for the Work that is in-process or upcoming.

- B. Each activity noted above shall be identified by activity number corresponding to the accepted CPM Construction Schedule and detailed description of the activity.
- C. The Look-Ahead Schedule shall be delivered to the Engineer twenty-four (24) hours prior to the weekly progress meeting.
- D. The Look-Ahead Schedule shall be in a format approved by the Engineer.
- E. Tabular reports for manpower and equipment resources shall be provided for and with each Look-Ahead Schedule.

SC-16.10 CPM Construction Schedule Revisions

- A. The Engineer may direct and, if so directed, the Contractor shall propose, revisions to the CPM Construction Schedule upon occurrence of any of the following instances:
 - 1. The actual physical progress of the Work falls more than five percent (5%) behind the accepted CPM Construction Schedule, as demonstrated by comparison to the accepted monthly CPM Construction Schedule updates or as determined by the Engineer if a current accepted CPM Construction Schedule does not exist.
 - 2. The Engineer considers milestone or completion dates to be in jeopardy because of "activities behind schedule". "Activities behind schedule" are all activities that have not or cannot be started or completed by the dates shown in the CPM Construction Schedule, regardless of the existence of positive float on the activity.
 - 3. A Change Order has been issued that changes, adds, or deletes scheduled activities or affects the time for completion of scheduled activities.
- B. When the instances requiring revision to the CPM Construction Schedule occur, the Contractor shall submit the proposed revised CPM Construction Schedule within ten (10) working days after receiving direction from the Engineer to provide such Schedule. No additional payment will be made to the Contractor for preparation and submittal of proposed revised CPM Construction Schedules. However, if the Engineer accepts the proposed revised CPM Construction Schedule, it shall replace and supersede all previous CPM Construction Schedules and substitute for the next monthly CPM Construction Schedule update that would otherwise be required.
- C. Revisions to the CPM Construction Schedule shall comply with all of the same requirements applicable to the original schedule.

SC-16.11 Schedule Recovery

- A. If a revised CPM Construction Schedule accepted by the Engineer requires the Contractor to employ additional manpower, equipment, hours of work or work shifts, or to accelerate procurement of materials or equipment, or any combination thereof, as schedule recovery measures to meet Contract milestones, the Contractor shall implement such schedule recovery measures without additional charge to the City. All schedules containing negative float shall mandate the submission of a recovery schedule.
- B. Furthermore, if efforts to recover are not deemed effective as determined by the Engineer, or if prior to submittal of the recovery schedule, the Engineer determines that critical milestones are in jeopardy, the Engineer may direct the Contractor to implement the above or any other recovery efforts at no additional costs to the City.

SC-16.12 Time Impact Analysis Requirement

- A. When delays are experienced by the Contractor and a time extension is requested, the Contractor shall submit to the Engineer a written Time Impact Analysis illustrating the influence of all changes or all delays on the current Project completion date. The time impact analysis shall be constructed on an As-Built Schedule Analysis approach. The As-Built Schedule that is created will incorporate all actual start and finish dates, actual durations of activities, actual sequences of construction (referred to as the As-Built Logic) current as of the time the Time Impact Analysis is performed. This Time Impact Analysis shall incorporate all delays (including Engineer, Contractor and third party delays without exception) in the time frame that they actually occurred with actual logic ties. The As-Built Schedule data shall be obtained from the most recent approved monthly schedule update. The As-Built Schedule shall be created as an early start schedule with the actual start and finish dates coinciding with the early start and finish dates from the most recent approved monthly schedule update. The As-Built Schedule shall show the original activity durations equal to the actual duration and the actual logic driving all activities. The Engineer will validate this As-Built Schedule. All requests for time extension shall be based upon an analysis of this As-Built Schedule. The critical path will be established and all Engineer -caused delays on the critical path will be identified. The time extension will be based solely upon the cumulative duration of all City and third party caused delays that are on the critical path. Any time extensions to the project's Interim Milestone Dates, if any, shall be non-compensable time extensions only.
- B. Each Time Impact Analysis shall demonstrate the estimated time impact based on the events of delay, the status of construction at that point in time, and the event time computation of all activities affected by the

change or delay. The event times used in the analysis shall be those included in the latest approved update of the project schedule, in effect at the time the change or delay was encountered.

SC-17 COOPERATION WITH OTHER CONTRACTORS AND FORCES

During progress of work under this Agreement, it will be necessary for other contractors and persons employed by the City to work in or about the Project. The City reserves the right to put such other contractors to work and to afford such access to the Site of the work to be performed hereunder at such times as the City deems proper. The Contractor shall not impede or interfere with the work for such other contractors engaged in or about the Services and shall so arrange and conduct his work that such other contractors may complete their work at the earliest date possible.

When the Contractor and any contractor or subcontractor performing Services under or pursuant to another City Agreement are employed on related or adjacent work, or are using the same materials source, storage area, or disposal area, the contractor shall be responsible to the other for any injury, damage, or loss caused the other by his operations, by his unnecessary delay or hindrance of the other's work, or by his failure to complete the Services or any portion thereof within the time specified for its completion. The Contractor shall indemnify and save harmless the City and the Engineer, and all officers and employees of the City connected with the Services from all claims, suits, or actions of any nature brought on account of any injury, damage, or loss.

Contractor's responsibilities under the preceding paragraph shall be not greater as to any injury, damage, or loss than those imposed on the Contractor or subcontractor under the comparable provision of this Agreement or subcontract.

The Engineer will decide any disputed questions regarding the performance of the Services, access and cleaning up of the site, and priority in all relations between the Contractor and other contractors in utility companies, and maintenance crews.

The Contractor shall cooperate with all other contractors requiring access to the Services for the purpose of maintenance of security, temporary facilities, cleaning of the site, and like matters requiring common effort.

SC-18 EXTENDED SHIFT, WEEKEND AND HOLIDAY WORK

The City observes the following holidays:

New Year's Day, Martin Luther King's Birthday, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and following Friday, and Christmas Day.

Should the Contractor deem it necessary to work on Saturdays, Sundays, holidays or longer than eight hours (8) per shift in order to comply with his construction schedule, or because of any emergency, the Contractor shall request permission of the Engineer to do so at least seven (7) calendar days in advance.

SC-19 PROJECT CLOSEOUT

SC-19.1 Restoration of Miscellaneous Surface Facilities

Construction operations on the Work may disturb or otherwise damage the surface contours and vegetation of natural and landscaped areas. Restoration of these areas shall be part of the Agreement. Restoration of pavements, trees, and ground vegetation is specified in the Technical Specifications.

SC-19.2 Pavement Restoration

Contractor shall secure permits from the appropriate jurisdictional Agency for all pavement restoration prepared in accordance with the requirements of the Agreement Documents and the jurisdictional Agency and submit them to the Engineer.

SC-20 EQUIPMENT SERVICE

The Contractor shall furnish the services of a competent factory representative of the manufacturer of the equipment to be installed, for the purpose of supervising and/or inspecting the installation, placing the equipment in service, and calibrating and adjusting each item of equipment. Qualification of the representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer. Where equipment furnished has significant process complexity, engineering personnel knowledgeable in the process involved and the function of the equipment shall be furnished. These services shall be furnished in accordance with the requirements of the Technical Specifications.

When approved by the Engineer, periods of service on more than one item of equipment furnished by the same manufacturer may run concurrently. Each of these manufacturers shall furnish supervisory and/or inspection services for all equipment, which he furnishes.

During the initial operation period, a functional test shall be performed on each piece of equipment. The test shall consist of operation of the equipment on a

normal duty cycle for a sufficient period of time to determine satisfactory operation (twenty-four [24] hours minimum). To the maximum extent practical, the full capabilities of all equipment shall be exercised, including remote operation, instrumented control schemes, alternate modes of operation, and emergency operation.

SC-21 CONCRETE POUR CARD

An approved concrete pour card must be obtained by the Contractor prior to the placement of concrete. The card shall be as provided to the Contractor by the Engineer. The pour card shall be completed by the contractor and approved by the Engineer before concrete is placed.

SC-22 PARTNERING STATEMENT

The City intends to encourage the foundation of a cohesive partnership with the Contractor and its subcontractors. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objectives are effective and efficient Agreement performance, intended to achieve completion within budget, on schedule, and in accordance with plans and specifications.

This partnership will be bilateral in makeup, and participation will be totally voluntary. Any costs associated with effectuating this partnership will be agreed to by both parties and will be shared equally with no change in Agreement price. To implement this partnership initiative, it is anticipated that within sixty (60) days of Notice to Proceed, the Contractor's on-site project manager and the City's on-site representative will attend a partnership development seminar followed by a team-building workshop, attended by key on-site staff from the Contractor's forces and City's personnel. Follow-up workshops will be held periodically through the duration of the Agreement as agreed by the Contractor and City. The City and Contractor shall mutually agree on a partnering facilitator and off-site facilities for the partnering sessions.

An integral aspect of partnering is the resolution of disputes in a timely, professional, and non-adversarial manner. Alternative dispute resolution methods will be encouraged to promote and maintain amicable working relationships at all levels of the project and to strengthen the partnership.

The mutual goals and objectives of the stakeholders form the Partnering Charter. The charter for each project, then, will be unique to that project. The charter may be a simple statement about communication and cooperation in all matters and resolution of conflicts at the lowest level. The following provides an idea of objectives, which might be included in the charter:

- A. We are a team dedicated to providing a quality project in accordance with the Agreement. We are committed to both employee and public safety, protection of the environment, and minimizing inconvenience to the public.
1. Communication Objectives: We intend to deal with each other in a fair, reasonable, trusting and professional manner including:
 - a. Communicate and resolve problems within the terms of the Agreement;
 - b. Decision making at the lowest possible level;
 - c. Open, honest communication;
 - d. Treat each other with mutual respect, resolve conflicts immediately, and avoid personal attacks;
 - e. Timely notification of future meetings; and
 - f. Do not allow personal antagonism to interfere with professionalism.
 2. Conflict Resolution System:
 - a. Step 1: It is preferred that conflict be discussed and resolved at the level on which it originates;
 - b. Step 2: When conflict is not resolved at the originating level, it is taken to the next level of supervision;
 - c. Step 3: When conflict is not resolved at the immediate supervisory level, it is taken to the project manager and engineer; and
 - d. Step 4: When conflict is not resolved by the project manager and engineer, it is submitted to the Disputes Review Board for adjudication.
 3. Performance Objectives:
 - a. Complete the project without litigation;
 - b. Utilize cost reduction incentive proposals;
 - c. Finish the project on time;
 - d. No delays to project;
 - e. No lost time injuries;
 - f. Promote positive public relations;
 - g. Make the project enjoyable to work on;
 - h. Render a finished product everyone can be proud of; and
 - i. Construct and administer the Agreement so that all parties are treated fairly.

SC-23 COLOR COORDINATION

The City will require a color coordination of architectural materials. All coatings are to be custom matched.

SC-24 TIE-INS OR MODIFICATIONS TO EXISTING SYSTEMS

Anytime the Contractor ties into or modifies an existing system, a detailed work plan shall be required. Submittal of this work plan must be a minimum of thirty (30) days in advance of commencement of the subject work. This work plan shall include a detailed description of the work, a step-by-step plan of the modification or tie-in, a schedule, a detailed list of materials and equipment required, demonstrated communications capacity, and a listing of any gates or valves, which must be operated. Working drawings shall be submitted as required under GC-28 for any permanent or temporary structural modifications. A temporary safety plan covering the period of the work, and a listing of contingency plans and supplies, including but not limited to spill prevention planning and spill containment kits, shall be required. A coordination meeting with the City's plant operating staff, the Contractor, the Engineer and the Designer must be held at least seven (7) days prior to the commencement of the modification or tie-in. The day before the commencement of the modification or tie-in, a final coordination shall be held giving final detailed work assignments to all parties involved.

The City and the Engineer have the right to require, at no additional cost to the City, stand-by equipment on any item(s) deemed critical enough to delay the work. The Contractor shall have available stand-by personnel to supplement the committed forces should problems arise. The Contractor is responsible for meeting all OSHA standards including entrance and exit safety, confined space entry, fall protection, scaffolding, rigging, etc.

SC-25 NOTICES OF COMMENCEMENT

- A. The Contractor shall file all "Notice of Commencement" required for this Project in accordance with O.C.G.A. § 36-91-92et. seq., as applicable, setting forth:
 - 1. The name, address, and telephone number of the person providing the labor, material, machinery, or equipment;
 - 2. The name and address of each person at whose instance the labor, material, machinery, or equipment is being furnished;
 - 3. The name and location of the public work; and
 - 4. A description of the labor, material, machinery, or equipment being provided and, if known, the Agreement Price or anticipated value of the labor, material, machinery, or equipment to be provided or the amount claimed to be due, if any.

- B. The Contractor shall respond to all requests for copies of a Notice of Commencement. Should the City or Engineer receive such a request, this request will be forwarded to the Contractor for further handling. The name and address of the City shall be as stated as follows:
- City of Atlanta
Department of Watershed Management
55 Trinity Avenue, S. W.
South Tower
Suite 5400
Atlanta, Georgia 30303
- C. The name and description of the Project shall be as stated in the Invitation to Bid.

SC-26 VALUE ENGINEERING CHANGE PROPOSALS (VECP)

(NOT IN USE)

SC-27 ENCOUNTERING HAZARDOUS OR POTENTIALLY HAZARDOUS MATERIAL DURING CONSTRUCTION ACTIVITIES

Provide all labor, materials, supplies, and incidentals to protect onsite workers and the surrounding public from exposure to potentially hazardous substances, prevent spread of potentially contaminated or hazardous substances, notify Engineer, and stop all work until notified by the Engineer.

An emergency situation or imminent hazard may include, but is not limited to, the following;

- o Buried drums or containers with unknown or known toxic contents.
- o Groundwater or soils of unnatural color
- o Spills or leaks of chemicals, solvents, or petroleum products.
- o Unusual odors
- o Other perceived threats

If a potentially hazardous substance is discovered during construction activities, do not remove it from the site. Leave the potentially hazardous substance in place and stop all work in the immediate area. If the material appears to be leaking or spreading, the Contractor shall contain or abate the spread of material. Take all measures to prevent the release of the material to the environment and protect all onsite workers and the public from potential exposure.

During the course of substance containment or evacuation of site personnel, the Contractor shall protect onsite workers, non-workers, and the general public from contact with or exposure to the contaminated substances or materials.

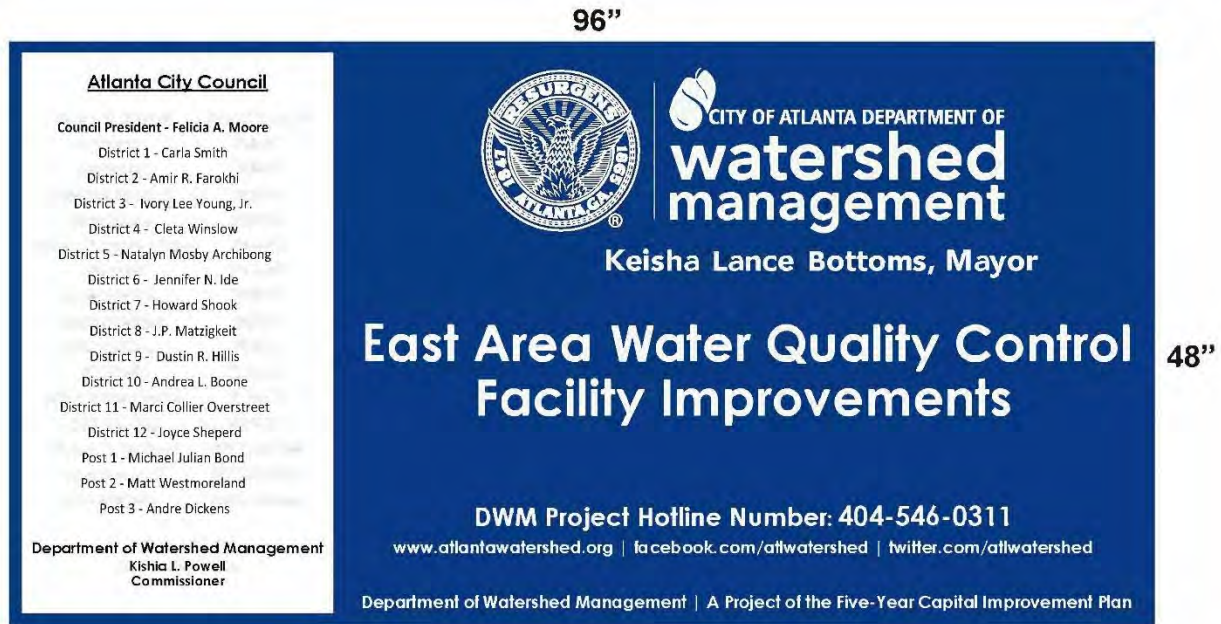
**SC-28 GEORGIA ENVIRONMENTAL FINANCE AUTHORITY
REQUIREMENTS**

This project will receive funding from the Georgia Environmental Finance Authority. Requirements are provided in Exhibit C.

ATTACHMENT 1 PROJECT SIGN

PROJECT SIGN required at entrance of project sites

Sample Project Sign



Notes:

1. 1 project sign will be provided for each project site. Update project name to "Flint River Pump Station Upgrade" and update DWM personnel and council members to reflect the organization at the time of the Notice to proceed.
2. Each sign shall be mounted on movable skids so that it can be relocated as the work progresses.
3. Location of signs shall be as directed by the Engineer.

TECHNICAL SPECIFICATIONS

CITY OF ATLANTA
FLINT RIVER PUMP STATION UPGRADE
IFB-XXXX

Seals for Technical Specifications are as follows:

Division 01, 09, and 10

Benjamin Moss, PE

Georgia Registration No. 041527



Division 02 and Specification 03055

Ira Battle, PE

Georgia Registration No. 033633



Division 03, 05, and 07 and Specifications 02365, 14300, and 14310

Carlos Gallo, SE

Georgia Registration No. 000153



Division 11, Specifications 14620, 15056, 15060, 15100, and 15262

Travis Thomas, PE

Georgia Registration No. 045302



Specification 15050, 15140, 15250, 15530, 15700, 15735, 15865, 15891, 15910, 15950, and 15990

Sunilsen S. Peramanu, PE

Georgia Registration No. 28455



Division 16 and 17

David Zimmer, PE

Georgia Registration No. 38080



SECTION 01005

MISCELLANEOUS REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

The Contractor shall conform to all miscellaneous requirements as herein specified.

1.2 INTERFERENCE WITH EXISTING WORKS

- A. The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works. The Contractor shall develop a program, in cooperation with the Engineer and plant personnel, which shall provide for the construction and putting into service of the new works in the most orderly manner possible. This program shall be adhered to except as deviations therefrom are expressly permitted. All work of connecting with, cutting into, and reconstructing existing pipes or structures shall be planned to interfere with the operation of the existing facilities for the shortest possible time when the demands on the facilities best permit such interference, even though it may be necessary to work outside of normal working hours to meet these requirements. Before starting work which will interfere with the operation of existing facilities, the Contractor shall do all possible preparatory work and shall see that all tools, materials, and equipment are made ready and at hand.
- B. The Contractor shall make such minor modifications in the work relating to existing structures as may be necessary, without additional compensation.
- C. The Contractor shall have no claim for additional compensation by reason of delay or inconvenience in adapting his operations to meet the above requirements.

1.3 MAINTAINING SEWAGE WATER, AND STORM WATER FLOWS AND OTHER UTILITIES AND PROCESS FLOWS

- A. It is essential to the operation of the existing facilities system that there be no interruption in the flow of aforementioned utilities, except as expressly scheduled in Section 01100. To this end, the Contractor shall provide, maintain, and operate all temporary facilities such as dams, pumping equipment, conduits, and all other labor and equipment necessary to intercept these utilities before it reaches the points where it would interfere with his work, carry it past its work, and return it to the existing utility below its work.

- B. The influent pump station shall be maintained at an acceptable water level to prevent backups in the upstream piping during construction activities.
- C. College park influent flows to the station must be maintained downstream of the Parshall flume which is monitoring flow rate. Water level downstream of the Parshall flume shall provide enough fall to prevent inaccurate flow readings.
- D. Effluent pump station elevation shall be maintained low enough to provide enough fall to prevent inaccurate flow readings from the pair of Parshall flumes entering the effluent wet well.

1.4 PHASE CONSTRUCTION

- A. The influent pump station grinder shall be installed and shall be subject to a 30-day run-time period with no shutdowns for greater than a 4-hour period prior to the installation of the new influent pump station pumps.
- B. The screening equipment shall be in full working order before proposed effluent pumps are installed and brought into service.

+++ END OF SECTION 01005 +++

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION

Summary: Major areas of the Work consist of, but are not limited to, the following items:

- A. Flint River Pump Station – Influent Pump Station
 - 1. Influent Pump Station
 - a. Influent manhole installation
 - b. Replacement of 6 pumps
 - c. Addition of grinder
 - d. Cantilever Jib Crane with electric hoist and controls.
 - e. Demolition of two wall and removal of grading and handrail equipment.
 - f. Instrumentation additions and replacement.
 - a) Pressure sensors for each pump
 - b) Ultrasonic level indicator
 - c) Float switches
 - d) Amp and runtime monitor for grinder.
 - 2. Electrical Building
 - a. Replacement of Motor Control Center
 - b. Addition of variable frequency drives for 10 pumps (6 in influent pump station, 3 in effluent pump station)
 - c. New control panels for I&C connection
 - d. New HVAC system
 - e. Roof repair/replacement; removal of abandoned equipment.
 - f. Drop ceiling replacement.
 - g. Insulated panel addition to electrical building.
 - 3. College Park Influent
 - a. Addition of grinder
 - 4. Screening Building
 - a. Addition of two bar screens
 - b. Addition of three gates with actuators.
 - c. Screw conveyor
 - d. Grading and roadway rehabilitation at dumpster location
 - 5. Effluent Pump Station
 - a. Replacement of 5 pumps
 - b. New individual pump valves and piping
 - c. New surge anticipator valve and associated piping
 - d. Cantilever Jib Crane

- e. New driveway on west side of effluent pump station for loading pumps from cantilever jib crane.
- f. Demolition and repair of concrete and handrails
- g. Instrumentation additions and replacement.
 - a) Pressure sensors for each pump
 - b) Pressure sensor for force main
 - c) Strap on flow meter for force main
 - d) Ultrasonic level indicator
 - e) Float switches
- h. Wastewater flow control measures, including but not limited to temporary bypass pumping systems (with full capacity redundancy) to maintain uninterrupted facility operations

The facility addresses are provided on the Drawings.

1.2 PERMITTING

- A. The Contractor shall be responsible for obtaining permits for the work specified in paragraph 1.1.
- B. The Contractor shall include in the base bid the cost associated with the permits required to perform the work described in paragraph 1.1.
- C. Contractor responsibility to determine fee amount for all permits. Contractor shall be required to go to COA Building Department to obtain the information and ask questions as required to determine the permit fees for site, building, electrical, plumbing, mechanical and electrical which will be included in the lump sum bid amount. Review of website or other methods to determine any COA fees are not acceptable.
- D. Contractor is advised the City of Atlanta building permit fee will be based on a percentage of the entire bid amount and will not exceed 0.7% of the entire bid amount including the allowances. This fee amount is in addition for other City of Atlanta fees for specific work and trades such as Electrical, HVAC, Plumbing, Elevator, Site Development and other work detailed in these contract documents.

1.3 SUBSTANTIAL COMPLETION AND FINAL COMPLETION DATES

- A. Project substantial completion - 540 days after NTP.
- B. Project final completion - 570 days after NTP.

+++ END OF SECTION 01010 +++

SECTION 01011

UNIQUE REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

The scope of this Section is to convey to the Contractor unique and unusual stipulations and requirements, which have been established for this Project. Some of the stipulations and requirements are a result of negotiations with various entities and organizations, which have an interest in this Project. Some requirements are based on technical aspects of the Project, which are not otherwise conveyed to the Contractor. The provisions of this Section shall supersede the provisions of the Division 1 through 17 Specifications, but shall not supersede the Bidding Requirements, Contract Forms or Conditions of the Contract.

1.2 EXISTING FACILITY OPERATIONS

- A. Influent flow for the influent pump station and the college park influent shall be maintained and managed to always prevent backups during construction. Contractor shall submit plans for by-pass management of each construction zone prior to the commencement of work at each area.
- B. The Contractor shall coordinate the Work with the City so that the construction will not restrain or hinder management of influent flows.
- C. After having coordinated the Work with the City, the Contractor shall prepare a submittal in accordance with Section GC-26 to include the time, time limits, and methods of each connection or alteration and have the approval of the City or the City's Engineer before any Work is undertaken on the connections or alterations.

1.3 SEQUENCING

- A. General: The Contractor shall be solely responsible for all construction sequencing.
- B. Notify the City at least 48 hours prior to impacting operations.
- C. Sequence Submittal:
 - 1. Submit a proposed sequence with appropriate times of starting and completion of tasks to the City Engineer for review.
 - 2. The Contractor may propose alternatives to the sequencing constraints shown in this Section and included within these Specifications in an attempt to reduce the disruption of the operation of the existing facility or streamline the Work. The City

and City Engineer are not obligated to accept any of these alternatives.

1.4 SITE SPECIAL REQUIREMENTS

A. General

1. Parking for Contractor personnel shall be fully contained within the site boundaries and the construction areas shown in the drawings. The driveway on the east side of the site shall have access at all times.
2. Contractor is advised there are numerous pressurized pipes, energized conduits and duct banks, overhead utilities, and gravity flow systems on the site. The Contractor is responsible for protecting the existing utility lines and shall be responsible for the repair and damages resulting from his construction activities to these systems. The Contractor is required to verify the actual locations of various buried lines shown in the Drawings by carefully excavated test pits and other direct means before starting Work in any given areas at no additional cost to the City. Special care shall be taken during any excavation to mitigate damage potential in case previously unknown and active systems are encountered. Overhead utilities may require raising or relocation to access site.
3. Unless shown otherwise on the Drawings, the Contractor shall restore the site to its original grade. Any fill placed at the site to return it to its original grade shall be controlled fill, approved by the Engineer. The site shall be grassed and strawed. Any final landscaping, including trees and shrubs, but not including grassing, shall be paid for under an allowance item.
4. The Contractor shall be responsible for maintaining and cleaning site access roads from the date it occupies the Site through the final completion of the construction period.

+++ END OF SECTION 01011 +++

SECTION 01014

WORK SEQUENCE

PART 1 - GENERAL

1.1 SCOPE

- A. Work under this Section includes construction sequencing and provision of temporary facilities necessary to maintain the ability of the City to receive and deliver wastewater during construction. The design flows for each facility are as follows:

Construction Area	Flow (MGD)
Influent Pump Station	20
College Park Influent	6
Screening Building	26
Effluent Pump Station	26

- B. The Contractor shall coordinate the work to avoid any interference with normal operation of plant equipment and processes. The Contractor shall comply with the following general requirements:
1. Provide temporary wastewater flow controls, including bypass pumping systems (with full capacity redundancy), and other facilities necessary to meet the requirements of this Section.
 2. Temporary wastewater flow controls shall be clearly identified on the Contractor's construction schedule and shall be submitted for City and Engineer review, discussion with the Contractor, and acceptance a minimum of 30 days prior to any scheduled implementation.
 3. Notify the City/Engineer at least 48 hours prior to implementation of previously accepted wastewater flow control plans impacting operations.
- C. Penalties imposed on the City as a result of any bypass caused by the actions of the Contractor, his employees, or subcontractors, shall be borne in full by the Contractor, including legal fees and other expenses to the City resulting directly or indirectly from the bypass.

1.2 SUBMITTALS

- A. The Contractor shall submit a detailed outage plan and time schedule for operations which will make it necessary to remove a tank, pipeline, channel, electrical circuit, equipment or structure from service. The schedule shall be coordinated with the construction schedule specified in

the Special Conditions and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor's method for wastewater flow controls to isolate the proposed work areas while preventing bypassing of other essential treatment units, the length of time required to complete said operation, the necessary plant, and equipment which the Contractor shall provide to prevent bypassing of associated treatment units.

- B. Sequence Submittal: The sequence provided in Part 3 of this Section is offered as a suggestion to the Contractor. Submit a proposed sequence with appropriate times of starting and completion of tasks to Engineer for review.
- C. Alternate Sequences: Contractor may propose alternate sequences to that shown in Part 3 of this Section in an attempt to reduce the disruption of the operation of the existing facility or streamline the tasks of this Contract.

1.3 QUALITY ASSURANCE

- A. At least 30 days prior to any proposed activity which will require any portion of the plant to be removed from operation, require bypassing, or require interruption of plant flow, the Contractor shall schedule a meeting with Plant Operating Personnel and the Engineer in preparation of submitting a wastewater flow control plan. The Contractor shall present it's detailed plan and procedures for the proposed operation. The plan shall meet the minimum requirements below:
 - 1. Plan shall be written outline form and presented in a format which shall show the progression of events in sequential and/or concurrent order of activity and the duration of each activity.
 - 2. The written plan shall be supplemented by flow calculations, drawings, sketches, and details as required to show the logic of the plan and make it understandable.
 - 3. The plan shall delineate the responsibilities of the Plant Operating Personnel and the Contractor, so as to eliminate any delay due to conflicting viewpoints upon implementation of the plan.
 - 4. After details of the plan, all details shall be incorporated into a formal submittal for final review and acceptance by the City and Engineer. A copy of the accepted plan and details shall be distributed to Plant Operating Personnel, the Engineer, and Contractor personnel at least one week prior to commencement of activities. Two days prior to commencement of activity a brief meeting of involved parties shall be convened. In this meeting the starting time and initial activity of Plant Operating Personnel and Contractor's personnel shall be agreed upon.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

The sequence of construction is outlined for the major items of Work required; no attempt has been made to describe every detail of the Project. The Contractor shall coordinate his work with the Plant Operating Personnel to minimize disruptions in plant operation. It shall be the Contractor's responsibility to ensure that all existing facilities are protected and will not be damaged as a result of this construction. No settlement of existing facilities will be acceptable and all work shall be performed in a safe manner.

3.2 FLINT RIVER PUMP STATION

- A. Influent flow for the influent pump station and the College Park influent shall be maintained and managed to always prevent backups during construction. Contractor shall submit plans for by-pass management of each construction zone prior to the commencement of work at each area.
- B. The Contractor shall coordinate the Work with the City so that the construction will not restrain or hinder management of influent flows.
- C. Phase 1: Bypass Influent PS from Upstream manhole to Effluent Pump Station
 - 1. Perform work in Influent PS, install grinder and new pumps.
- D. Phase 2: Bypass Effluent PS from Influent PS to South River force main / Bypass College Park
 - 1. Perform work in Effluent PS
 - 2. Perform work in Screenings Bldg
 - 3. Perform Electrical Bldg Work
 - 4. Perform work for College Park grinder

+++ END OF SECTION 01014 +++

SECTION 01016

OCCUPANCY

PART 1 - GENERAL

1.1 PARTIAL OCCUPANCY BY CITY

Whenever, in the opinion of the Engineer, any section or portion of the Work is in suitable condition, it may be put into use upon the written order of the Engineer and such usage will not be held in any way as an acceptance of said work, or any part thereof, or as a waiver of any of the provisions of these Specifications and the Contract. Pending completion and final acceptance of the Work, all necessary repairs, and replacements, due to defective materials or workmanship or operations of the Contractor, for any section of the Work so put into use shall be performed by the Contractor at Contractor's own expense.

+++ END OF SECTION 01016 +++

SECTION 01040

COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Coordinate execution of the Work with other Contractors, subcontractors, and the Engineer as required to maintain operation of the existing facilities and satisfactory progress of the Work.
- B. Requirements of this Section will be in addition to those stated in the General Conditions.
- C. The Engineer may require a written explanation of the Contractor's plan for accomplishing separate phases of the Work.

1.2 CUTTING AND PATCHING

- A. The Contractor shall leave all chases or openings for the installation of its own or any of its subcontractor's work, or shall cut the same in existing work, and shall see that all sleeves or forms are at the work and properly set in ample time to prevent delays. See that all such chases, openings and sleeves are located accurately and are of proper size and shape, and shall consult with the Engineer and its subcontractors concerned in reference to this work. In case of its failure to leave or cut all such openings or have all such sleeves provided and set in proper time, the Contractor shall cut them or set them afterwards at its own expense, but in so doing shall confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall structural members be cut without the written consent of the Engineer.
- B. Carefully fit around, close up, repair, patch, and point around the work specified herein to the satisfaction of the Engineer.
- C. All of this work shall be done by careful workers competent to do such work and with the proper small hand tools. Power tools shall not be used except where, in the opinion of the Engineer, the type of tool proposed can be used without damage to any work or structures and without inconvenience or interference with the operation of any facilities. The Engineer's concurrence with the type of tools shall not in any way relieve or diminish the responsibility of the Contractor for such damage, inconvenience, or interference resulting from the use of such tools.
- D. Do not cut or alter the work of any subcontractor, except with the written consent of the subcontractor whose work is to be cut or altered, or with the

written consent of the Engineer. All cutting and patching or repairing made necessary by the negligence, carelessness or incompetence of the Contractor or any of its subcontractors, shall be done by, or at the expense of, the Contractor and shall be the responsibility of the Contractor.

1.3 EXISTING UTILITIES

- A. Consult with the Engineer on a daily basis while the Contractor is performing demolition, excavation, or any other alteration activity. No equipment, utility or structure is to be altered, shut off or removed unless approved in advance, and in writing, by the Engineer. The Contractor shall give the Engineer at least 48 hours advanced notice, in writing, of the need to alter, shut off or remove such function.
- B. Coordinate the Work with the Engineer and revise daily activities if needed so as to not adversely affect system operations. Such revisions in the proposed work schedule will be accomplished with no additional compensation to the Contractor.
- C. Comply with the requirements of Section 01011 of these Specifications.

+++ END OF SECTION +++

SECTION 01045

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 DEFINITIONS

Definition: "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

- A. Cutting and patching is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
- B. Cutting and patching performed during the manufacture of products, or during the initial fabrication, erection or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching".
- C. "Demolition" and "Selective Demolition" are recognized as related- but- separate categories of work, which may or may not require cutting and patching as defined in this section; refer to Division 2 for additional requirements.

1.2 SECTION INCLUDES

- A. This Section specifies administrative and procedural requirements for cutting and patching.
- B. Refer to other sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 QUALITY ASSURANCE

- A. Requirements for Structural Work. Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:

- 1. Primary operational systems and equipment.
- 2. Air or smoke barriers.
- 3. Water, moisture, or vapor barriers.
- 4. Fire Protection Systems.

5. Control Systems.
 6. Communication systems.
 7. Conveying systems
 8. Noise and vibration control elements and systems.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decrease operational life or safety.
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in visually unsatisfactory manner.

If possible, retain the original installer or fabricator to cut and patch the exposed Work listed below. If it is impossible to engage the original installer or fabricator, engage another recognized experienced and specialized firm.

1. Stonework and stone masonry.
 2. Window wall systems.
 3. Ornamental metal.
 4. Firestopping
 5. Stucco and ornamental plaster.
 6. Carpeting.
 7. Wall Coverings.
- D. Before cutting and patching the following categories of work, obtain approval to proceed.
1. Structural steel.
 2. Miscellaneous structural metals, including lintels, equipment supports, stair systems and similar categories of work.
 - a. Structural concrete.
 - b. Foundation construction.
 - c. Steel.
 - d. Lintels.
 - e. Bearing and retaining walls.
 - f. Structural decking.
 - g. Exterior curtain wall construction.
 - h. Equipment Supports.
 - i. Piping, ductwork, vessels and equipment.
 - j. Structural systems of special construction, as specified by Division- 13 sections.
 - k. Shoring, bracing, and sheeting.
 - l. Primary operational systems and equipment.

- m. Water/moisture/vapor/air/smoke barriers, membranes and flashings.
 - n. Noise and vibration control elements and systems.
 - o. Control, communication, conveying, and electrical wiring systems.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.
- F. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.4 SUBMITTALS

Procedural Proposal for Cutting and Patching: Where prior approval of cutting and patching is required, submit proposed procedures for this work well in advance of the time work will be performed and request approval to proceed. Include the following information, as applicable, in the submittal:

- A. Describe nature of the work and how it is to be performed, indicating why cutting and patching cannot be avoided. Describe anticipated results of the work in terms of changes to existing work, including structural, operational and visual changes as well as other significant elements.
- B. List products to be used and firms including their qualifications that will perform work.
- C. Give dates when work is expected to be performed.
- D. List utilities that will be disturbed or otherwise be affected by work, including those that will be relocated and those that will be out-of-service temporarily. Indicate how long utility service will be disrupted.
- E. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of unsatisfactory work.
- F. When cutting and patching of structural work involves the addition of reinforcement, submit details and engineering calculations to show how that reinforcement is integrated with original structure to satisfy requirements.

1.5 WARRANTY

Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any existing warranties or warranties on Work included in the contract.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Except as otherwise indicated, or as directed by the Contracting Officer, use materials for cutting and patching that are identical to existing materials. If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials for cutting and patching that will result in equal-or-better performance characteristics.

The use of a trade name and suppliers name and address is to indicate a possible source of the product. Products of the same type from other sources shall not be excluded provided they possess like physical and functional characteristics.

- B. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before cutting existing surfaces examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
- B. Before cutting, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.

Before the start of cutting work, meet at the work site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict between the various trades. Coordinate layout of the work and resolve potential conflicts before proceeding with the work

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for

portions of the Project that might be exposed during cutting and patching operations.

- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Take precautions necessary to avoid cutting existing pipe conduit, or ductwork serving the building, but schedule to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original conditions.
- C. Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original installer; comply with the original installer's recommendations.
 - 1. In general, where cutting is required, use hand or small tools designed for sawing or grinding, no hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. To avoid marring existing finish surfaces, cut the exposed or finished side into concealed surfaces.
 - 3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
 - 4. Comply with requirements of applicable Sections or Division-2 where cutting and patching require excavating and backfilling.
 - 5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- D. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
 - 1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. When removal of walls or partitions extends one finish area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, as necessary to achieve uniform color and appearance.

Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken area containing the patch, after the patched area has received primer and second coat.

4. Patch, repair or rehang existing ceiling as necessary to provide an even surface of uniform appearance.

3.4 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Completely remove paint, mortar, oils, putty, and items of similar nature. Thoroughly clean piping, conduit and similar features before paint or other finishing is applied. Restore damaged pipe covering to its original conditions.
- B. Do not permit traffic over unprotected floor surface.

+++ END OF SECTION 01045 +++

SECTION 01060

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. Permits and Responsibilities: The Contractor shall, without additional expense to the City, be responsible for obtaining NPDES land disturbance permits for storm water discharges from this project, and for complying with any applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work.
- B. The Contractor shall take proper safety and health precautions to protect the Work, the workers, the public and the property of others.
- C. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the Work, except for any completed unit of construction thereof which may heretofore have been accepted.
- D. The Contractor shall, without additional expense to the City, be responsible for obtaining all building permits, and for complying with any applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work. Work may include, but not be limited to:
 - a. COA Building permits
 - b. COA Fire review permits
 - c. COA Public utility permit
 - d. COA Water service permit
 - e. COA Urban design Commission approval
 - f. NPDES Notice of Intent

The Contractor shall, without additional expense to the City, be responsible for obtaining and paying for all site development permits and fees, and for complying with any applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work. Work may include, but not be limited to:

- g. COA Land disturbance permits
- h. COA Site development permits

The Contractor shall, without additional expense to the City, be responsible for obtaining all electrical, HVAC, and plumbing permits, and for complying with any applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work. Work may include, but not be limited to:

- i. COA Electrical permits
- j. COA Mechanical/HVAC permits
- k. COA Plumbing permits
- l. COA Fire sprinkler permits
- m. COA Temporary power permits

The Contractor shall, without additional expense to the City, be responsible for obtaining, all demolition permits, and for complying with any applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work. Work may include, but not be limited to:

- n. Required submittal for demolition permits
- o. Rodent inspection for buildings to be demolished
- p. Rodent letter from extermination company
- q. Hauling permit

- E. The Contractor shall take proper safety and health precautions to protect the Work, the workers, the public and the property of others.
- F. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the Work, except for any completed unit of construction thereof which may heretofore have been accepted.
- G. Permit Fees: The Contractor must be prepared to pay for ALL permit fees, and must include these fees in their bid. A limited list of permit fees expected, from the City of Atlanta, Office of Buildings, is shown below – **this is not a complete list of permit fees, and does not include fees from other than the City of Atlanta.** The Contractor must verify these fees, as they are subject to change.

Fee Type	Base Fee	Technology Fee	Minimum Permit Fee Amount
Building Permit Fees	\$150	\$25	\$175
	<i>\$7 per \$1,000 of cost of construction (applies to entire contract amount including allowances)</i>		
Electrical Permit	\$150	\$25	\$175
Mechanical / HVAC Permit	\$150	\$25	\$175
Plumbing Permit	\$150	\$25	\$175
Temporary Power Permit	\$150	\$25	\$175
Public Utility Permit	\$150	\$25	\$175

- H. City of Atlanta, Office of Buildings contact for building-related permits: Ms. Mary A. Miller, (404) 330-6691, or mamiller@atlantaga.gov.

1.2 NPDES PERMITS FOR STORM WATER DISCHARGES

- A. The Federal Water Pollution Control Act (also known as the Clean Water Act (CWA)), as amended in 1987, requires National Pollutant Discharge Elimination System (NPDES) permits for storm water discharges associated with industrial activity.
- B. On November 16, 1990, (55 FR 47990), the Environmental Protection Agency (EPA) issued regulations establishing permit application requirements for storm water discharges associated with industrial activity. These regulations are primarily contained in Section 122.26 of Section 40 of the Code of Federal Regulations (40 CFR Part 122.26).
- C. The November 16, 1990 regulation established the following definition of "storm water discharge associated with industrial activity" at 40 CFR 122.26(b)(14):

"Storm water discharge associated with industrial activity" means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. For the categories of industries identified in subparagraphs (i) through (x) of this subsection, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at 40 CFR 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. The following categories of facilities are considered to be engaging in "industrial activity" for purposes of this subsection:

(ix) and (xi) omitted for brevity.

(x) Construction activity including clearing, grading and excavation activities except: operations that result in the disturbance of less than five acres of total land area which are not part of a larger common plan of development or sale;

- D. These regulations are effective for all activities covered by the regulation on or after October 1, 1992.

- E. As a minimum, the Contractor shall complete EPA Form 3510-2F. A manual entitled "Guidance Manual for the Preparation of NPDES Permit Applications for Storm Water Discharges Associated With Industrial Activity" as published by the United States Environmental Protection Agency, is available to assist the Contractor in the application process.

+++ END OF SECTION 01060 +++

SECTION 01100

SPECIAL PROJECT PROCEDURES

PART 1 - GENERAL

1.1 CONNECTIONS TO EXISTING SYSTEMS

The Contractor shall perform all work necessary to locate, excavate, and prepare for connections to the terminus of the existing systems as shown on the Drawings. The cost for this work and for the actual connection to the existing systems shall be included in the bid price for the project and shall not result in any additional cost to the City. Connections shall be made only after approval by the Engineer.

1.2 RELOCATIONS

The Contractor shall be responsible for the relocation of structures, including but not limited to light poles, signs, sign poles, fences, piping, conduits, and drains that interfere with the positioning of the Work as set out on the Drawings. The cost of all such relocations shall be included in the bid price.

1.3 EXISTING UNDERGROUND PIPING, STRUCTURES, AND UTILITIES

- A. The attention of the Contractor is drawn to the fact that during excavation, the possibility exists of the Contractor encountering various water, gas, telephone, electrical, or other utility lines not showed on the Drawings. The Contractor shall exercise extreme care before and during excavation to locate and flag these lines so as to avoid damage to the existing lines. Should damage occur to an existing line, the Contractor shall repair the line at no cost to the City.
- B. The locations of existing underground piping structures and utilities are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping to be encountered.
- C. The existing piping and utilities that interfere with new construction shall be rerouted as shown, specified, or required. Before any piping and utilities not shown on the Drawings are disturbed, the Contractor shall notify the Engineer of the location of the pipeline or utility and shall reroute or relocate the pipeline or utility as directed.
- D. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities, which do not interfere with complete work, shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at its expense as directed by the Engineer.

1.4 HAZARDOUS LOCATIONS

The existing wet wells, manholes, channels, and related areas are hazardous locations, in that explosive concentrations of sewage gas may be present. The Contractor is cautioned that the above areas, especially the wet well, may be deficient in oxygen. Checks shall be made by the Contractor whenever personnel are working in these areas to determine if adequate oxygen is available.

1.5 CONNECTIONS TO WORK BY OTHERS

Not used.

1.6 WATER FOR CONSTRUCTION PURPOSES

All water for testing, flushing and construction shall be furnished by the City, as required and agreed upon by the City. The City shall have the option of recouping the cost of plant water usage. It may be available by connecting to the City's water system at a point approved by the Engineer. There shall be installed in each and every connection to the City's potable water supply, a meter and a backflow preventer meeting the requirements of the City of Atlanta, Department of Water.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+++ END OF SECTION 01100 +++

SECTION 01200

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SCOPE

- A. Work includes furnishing all plant, labor, equipment, tools, materials, wastewater flow control (i.e., by-pass pumping), and performing all operations required to complete the Work satisfactorily, in-place, as specified and as indicated on the Drawings.
- B. All costs of required items of work and incidentals necessary for the satisfactory completion of the Work shall be considered as included in the Total Bid. The cost of work not directly covered by the pay items shall be considered incidental to the contract and no additional compensation shall be allowed.
- C. The Contractor shall take no advantage of any apparent error or omission on the Drawings or Specifications, and the Engineer shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.

1.2 SUBMITTALS

- A. The Contractor shall submit to the Engineer for approval, in the form directed or acceptable to the Engineer, a complete schedule of values of the various portions of the Work, including quantities and unit prices, aggregating the Contract Price. An unbalanced breakdown providing for overpayment to the Contractor on items of Work, which would be performed first, will not be approved.
- B. Submit application for payment on a form approved by the Engineer showing allowances, lump sum schedule of value items, and unit price items in accordance with Section SC 16.

1.3 LUMP SUM ITEMS

- A. Payment of the lump sum items established in the Contractor's Bid shall be full compensation for all plant, labor, tools, materials, wastewater flow controls, and equipment required to furnish, install, construct, and test the Work covered under the lump sum bid item.
- B. The lump sum items shall be specifically subdivided by Activity, broken out in the Schedule of Values.

- C. Payments for the lump sum items specifically broken out in the Schedule of Values will be based upon physical progress for each activity in accordance with the breakdown of the Lump Sum prices agreed to in the Schedule of Values.

1.4 UNIT PRICE ITEMS

- A. Payment for all work shall be in accordance with the unit price bid items in the Bid Schedule and shall be full compensation for all labor, materials, and equipment required to furnish, install, construct, and test the Work covered under the unit price bid item. Work for which there is no price schedule item will be considered incidental to the Work and no additional compensation shall be allowed.
- B. Payment will be made only for the actual quantities of work performed in compliance with the Drawings and Specifications. The Contractor will be paid an amount equal to the approved quantity times applicable unit price. Any unused balance of the unit price work shall revert to the City upon completion of the project.
- C. All unit price work shall be considered as part of the Work to be performed within the time limits specified elsewhere for Substantial Completion and Project Completion. No increase in contract time will be allowed for increases in quantities of unit price work performed beyond the quantities shown in the Bid Schedule, unless it can be demonstrated that the additional Work performed under the unit price item is on the critical path of the Project Schedule.

1.5 MEASUREMENT OF QUANTITIES

- A. Final payment quantities shall be determined from the record drawings. The record drawing lengths, dimensions, quantities, etc. shall be determined by a survey after completion of all required work. The precision of final payment quantities shall match the precision shown for that item in the Bid Schedule. Measurements will be taken according to the United States standard measurements and in the manner as specified in these Specifications.
- B. Measurement Devices:
 - 1. Scales shall be inspected, tested, and certified by the applicable Weights and Measures Department within the past year and shall be of sufficient size and capacity to accommodate the conveying vehicle.
 - 2. Metering devices shall be inspected, tested, and certified by the applicable department within the past year.
 - 3. Volume shall be determined by cubic dimension by multiplying mean length by mean width by mean height or thickness.

4. Area shall be determined by square dimension by multiplying mean length by mean width or height.
5. Linear measurement shall be measured by linear dimension, along the item centerline or mean chord.
6. Stipulated price measurement shall include items measured by number, weight, volume area, length or combination thereof as appropriate.

Item	Method of Measurement
AC	Acre—Field Measure
AL	Allowance
CY	Cubic Yard—Field Measure within limits specified or shown, or measured in vehicle by volume, as specified
EA	Each—Field Count
GAL	Gallon—Field Measure
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure
LS	Lump Sum—Unit is one; no measurement will be made
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)
VF	Vertical Foot—Field Measure

1.6 ALLOWANCES

- A. The allowances specified in the Bid Schedule are to establish a fund to pay the cost of items for which the City could not establish accurate quantities and/or detailed scope of work. This work shall be completed only at the written direction of the Engineer, and the cost of such work shall be approved prior to performance of the work.
- B. The Contractor shall be responsible for the payment for these services to the appropriate payee providing such service, and shall submit evidence of payments to the Engineer prior to its inclusion in the progress payments.
- C. Payment will be made for invoices submitted by the Contractor subject to the conditions and limitations in the Contract Documents. Unless expressly indicated otherwise in allowance item descriptions below, all Contractor costs associated with the Work shall be determined as prescribed in the General Conditions, GC-41.2.4, Force Account Work.

- D. Allowance allocations shall only be paid to the Contractor for completed work authorized by the Engineer. All allowance dollar amounts not expended shall revert to the City at the completion of the project. Should the final allowance costs be less than the specified amount of the allowance, the Contract will be adjusted accordingly by change order. The amount of change order will not recognize any changes in handling costs at the site, labor, overhead, profit and other expenses caused by the adjustment to the allowance item.

1.7 ITEM NO. 1.1 – FLINT RIVER PUMP STATION UPGRADES

- A. Measurement for payment shall be per lump sum.
- B. All Work required to provide complete and fully functional systems at the Flint River Pump Station in accordance with the drawings and technical specifications.
- C. Roof repair and sealing for the electrical building will have an allowance value of twenty thousand dollars and zero cents (\$20,000.00) to account for removal of abandoned equipment and to make necessary repairs to prevent leaking.
- D. All mobilization and demobilization costs shall be included in this Bid Item. This shall include costs for all sites where Work is shown or specified.

1.8 ITEM NO. 2.1 – HELICAL PILES

- A. Measurement shall be per vertical linear foot (VF).
- B. Payment at the unit price bid shall be full compensation for mobilization of equipment, drilling of piles, and all other Work for complete installation as shown and specified.
- C. Final depth of pile shall be determined in the field at the time of drilling based on pile design specified.

1.9 ITEM NO. 2.2 – TREE FENCE

- A. Measurement shall be per linear foot (LF).
- B. Payment at the unit price bid shall be full compensation for required mobilizations for installation and maintenance during construction.

1.10 ITEM NO. 2.2 – TEMPORARY GRASS/MULCH

- A. Measurement shall be per square yard (SY).

- B. Payment at the unit price bid shall be full compensation for required mobilizations for installation and maintenance during construction.
- 1.11 ITEM NO. 2.3 – PERMANENT GRASS (SOD)
 - A. Measurement shall be per square yard (SY).
 - B. Payment at the unit price bid shall be full compensation for required mobilizations for installation and maintenance during construction.
- 1.12 ITEM NO. 2.5 – RIP RAP
 - A. Measurement shall be per ton (TON).
 - B. Payment at the unit price bid shall be full compensation for required mobilizations for installation and maintenance during construction.
- 1.13 ITEM NO. 2.6 – CONSTRUCTION ENTRANCE
 - A. Measurement shall be per unit (EA).
 - B. Payment at the unit price bid shall be full compensation for required mobilizations for installation and maintenance during construction.
- 1.14 ITEM NO. 2.7 – INLET PROTECTION (FILTER SOCK)
 - A. Measurement shall be per unit (EA).
 - B. Payment at the unit price bid shall be full compensation for required mobilizations for installation and maintenance during construction.
- 1.15 ITEM NO. 2.8 – INLET PROTECTION (FILTER FABRIC)
 - A. Measurement shall be per unit (LF).
 - B. Payment at the unit price bid shall be full compensation for required mobilizations for installation and maintenance during construction.
- 1.16 ITEM NO. 3.1 – ELECTRICAL BUILDING ROOF REPAIR
 - A. Measurement for payment shall be by allowance which will be reviewed by Submittal and approved by OWNER or ENGINEER.
 - B. Roof repair and sealing for the electrical building will have an allowance value of twenty thousand dollars and zero cents (\$20,000.00) to account for removal of abandoned equipment and to make necessary repairs to prevent leaking.
- 1.17 ITEM NO. 3.2 – PARTNERING

An allowance has been established as the value of this item. This allowance may be used to pay the City's 50 percent share of the costs of an outside facilitator and conference facilities to conduct partnering in accordance with these Specifications. The Contractor's costs for attending and participating in the partnering sessions is not covered under this allowance item and all such costs shall be included in Lump Sum Bid amount for All Other Work. The Contractor shall allocate an amount equal to this allowance in its Lump Sum Bid for paying its 50 percent share of the direct Partnering costs. Any unused portion of the amount allocated by the Contractor for its 50 percent share of the direct costs of Partnering shall be credited to the City on the Final Payment Request. Payments by the Contractor under this allowance are considered as "pass through costs" for which the Contractor will not be entitled to any markup.

1.18 ITEM NO. 3.3 – UNFORESEEN CONDITIONS

An allowance has been established to be used to pay the costs for Unforeseen Conditions encountered and addressed as directed by the OWNER or ENGINEER. This allowance covers the cost of relocating utilities or other structures, demolishing structures not shown on the Drawings, and replacement or repair of small equipment, valves, piping, or pipe supports indicated on the Drawings as requiring inspection and repair or replacement but not explicitly shown on the Drawings as requiring replacement.

1.19 ITEM NO. 3.4 – TREE REMOVAL RECOMPENSE

An allowance has been established as the value of this item. This allowance may be used to pay the costs associated with removal of trees as may be required for the Work and approved for removal by permit issued by the City of Atlanta, Arborist Division.

1.20 ITEM NO. 1.6 – HANDRAIL AND GRATING REPLACEMENT

An allowance has been established as the value of this item. This allowance may be used to pay the costs associated with removal of handrail and grating as may be required for the Work and approved for removal by the City of Atlanta.

+++END OF SECTION +++

SECTION 01310

SCHEDULING THE WORK

PART 1 – GENERAL

1.1 SCOPE

- A. This section describes the scheduling and progress reporting requirements of the Contract. The primary objectives of the requirements of this Section are:
1. To assist the City and Engineer in evaluating the progress of the Work.
 2. To provide for optimum coordination and sequencing of the Work by the City, Contractor, and any related work or services provided by other parties which may affect the Project.
 3. To permit the timely prediction or detection of events or occurrences that might affect the timely prosecution of the Work.

1.2 GENERAL SCHEDULING REQUIREMENTS

- A. The Work of this Contract shall be planned, scheduled, executed, and reported using the critical path method (CPM). Through the Mobilization / Project Management / Demobilization bid item, the Contractor shall purchase and use the following software program to develop its Schedule Submittal:
1. Primavera Engineering and Construction, version to be specified by the Engineer
- B. A comprehensive schedule shall be developed by the Contractor and submitted to the Engineer for review prior to commencement of said work. Upon acceptance by the Engineer, the schedule will be merged into the City's overall schedule.
- C. At a minimum, the schedule shall include the activities for each asset as deemed appropriate to clearly illustrate and document the Work. The activities listed below are repetitive for the same type of rehabilitation when organized on an asset basis and generally considered standard industry practice. This set of standard activities will be used to harmonize multiple rehabilitation contracts by the City and shall not be revised or in text or grouping without approval from the Engineer.

Planning & Administrative Activities by Contract Type:

Description	Contract Type
Bond & Insurance Submittal	ALL
Product Submittals	ALL

Permits	ALL
Right of Entry Acquisition	N/A
72 Hour Disruption Notice	N/A
Door Hanger Notification	N/A
Application for Payment Submission	ALL
Application for Payment Review	ALL
Project Record Submittals	ALL
Project Closeout Document Submittals	ALL

Construction Activities by Rehabilitation Type:

Description	Rehab Type
Pre-Construction Survey	ALL
Locate Existing Utilities	N/A
Install Access Road	ALL
Install/ Maintain/ Remove Traffic Control	ALL
Install/ Maintain/ Remove Bypass Pumping	ALL
Pre-CCTV Existing Pipeline	N/A
Rehabilitate Service Laterals	N/A
Precondition Existing Pipeline	N/A
Install Liner/ Reinstate Services	N/A
Install Launch Pit/ PB / Reinstate Services	N/A
Install New Pipeline/ Reinstate Services	N/A
Post CCTV Review	N/A
Post CCTV Submission to COA	N/A
Manhole Rehabilitation	N/A
Test New Installation	ALL
Site Restoration	ALL
Pavement Replacement	ALL
Asphalt Pavement Milling & Topping	N/A

Milestones by Contract Type:

Description	Contract Type
Contract Execution	ALL
Notice to Proceed	ALL
Pre-construction Meeting	ALL
(" ") Public Information Meeting	ALL
Trial Test Methodology Acceptance	ALL
Storm drainage basin (" ") Substantial Completion	ALL
Storm drainage basin (" ") Final Completion	ALL
Contract Substantial Completion	ALL
Contract Final Completion	ALL

D. The Schedule Submittal, as defined herein, shall represent the Contractor's commitment and intended plan for completion of the Work in compliance with the Flint River Pump Station Upgrade 01310-2

Contract completion date and interim milestone dates specified. The Schedule Submittal shall take into account all foreseeable activities to be accomplished by any separate consultants or the City, and interface dates with utility companies, the City's operations, and others. The Schedule Submittal shall anticipate all necessary manpower and resources to complete the Work within the dates set forth.

- E. Once reviewed and accepted by the Engineer, the Schedule Submittal will become the Schedule of Record.
- F. The Contractor is responsible for determining the sequence of activities, the time estimates of the detailed reconnaissance/investigative and rehabilitation activities, as well as the means, methods, techniques and procedures to be employed. The schedule shall clearly indicate the proposed sequence of work. The Schedule of Record shall represent the Contractor's best judgement of how it will execute the Work in compliance with the Contract requirements. The Contractor shall ensure that Schedule of Record is current and accurate and is properly and timely monitored, updated and revised as Project conditions and the Contract Documents may require.
- G. The City will work with the Contractor to assign and schedule the work in a logical and efficient manner. However, all items in this contract shall be priced such that each item can be assigned independently or combined at the City's sole discretion, in regard to both quantity and scope. There shall be no consideration of any claim for extra payment arising from a decision by the City to assign potential work items under this contract in any combination or in combination with another contract utilizing alternate technologies.

1.3 SCHEDULE SUBMITTALS

- A. The Contractor shall submit the qualifications of the scheduler(s) proposed to be used on the project immediately after NTP. The scheduler(s) is subject to the approval of the Engineer. The Contractor shall use the services of a scheduler(s) who has verifiable training and credentials in preparing and maintaining a computerized CPM Construction Schedule using Primavera software as specified herein. The qualifications of the scheduler(s) should be a minimum of 4 years experience in project scheduling for civil, structural, architectural, or related engineering disciplines. The scheduler(s) should have direct experience developing, maintaining, updating, modifying project schedules utilizing Primavera products, ideally Primavera Engineering and Construction. The cost for providing a qualified scheduler(s) shall be included in the Project Control Tools bid item.
- B. Within 30 days from receipt of Notice to Proceed, a baseline / comprehensive schedule shall be submitted by the Contractor to the Engineer for approval. The Contractor shall submit the complete schedule in electronic format as directed by the Engineer. At a minimum, the schedule output shall include the following:
 - 1. Activities with attributes or codes
 - 2. Estimated activity durations in working days. (Not to exceed 15 working days for the construction activities.)

3. All logic ties
 4. The critical path activities differentiated from other activities
 5. All activities for submittal of shop and working drawings, videos, test results, procurement, fabrication, delivery, installation and testing of critical materials.
 6. Related activities shall be grouped on the network diagram
 7. A time scale located at the top and/or bottom of the network diagram showing calendar days and months
 8. Earliest start date
 9. Earliest finish date
 10. Actual start date
 11. Actual finish date
 12. Latest start date
 13. Latest finish date
 14. Calendar Definition
 15. Total float
 16. All constraints
 17. Lag – No lag is allowed in the baseline/ comprehensive schedule
 18. Monetary value of activity (from Schedule of Values)
- C. The Contractor shall participate in a review and evaluation of the baseline schedule with the Engineer. Any revisions necessary as a result of this review shall be resubmitted to the Engineer within 10 calendar days after the conference. The mutually acceptable schedule shall then be used by the Contractor for planning, organizing and directing the work and for reporting progress. If the Contractor desires to make changes in its method of performing the Work, he shall notify the Engineer in writing stating the reason for the changes.
- D. The Contractor shall demonstrate competence in the use of CPM scheduling through the submission of a fully compliant CPM Construction Schedule with the initial CPM submission. In the event the Contractor fails to provide a baseline schedule in a timely manner or fails to demonstrate competence in the CPM scheduling, the Engineer may direct the Contractor to employ the services of a Scheduling Firm that can demonstrate competence. The Contractor shall comply with such directive at no additional cost to the City.
- E. Each activity shall use the following format:
- xxxx.yyyyyy
- Where xxxx is the last four digits of the contract number (IFB #), and yyyyyy is for the Contractor's use according to a template provided by the Engineer at the pre-construction conference.
- F. Activities and milestones to appear on the Schedule Submittal shall include, but not be limited to, City reviews that impact the Work, obtaining required permits, dewatering and dredging, sitework, paving, submittals, coordination requirements, and dates of Substantial and Final Completion.

- G. The Engineer shall have the right to require the Contractor to modify any portion of the Contractor's Schedule Submittal, or Recovery Schedule, as herein required, (including cost loading) with the Contractor bearing the expense thereof, which the Engineer reasonably determines to be:
1. Impractical or unreasonable
 2. Based upon erroneous calculations or estimates
 3. Required to ensure proper coordination by the Contractor of the Work of its subconsultants and with the work or services being provided by any separate consultants
 4. Necessary to avoid undue interference with the City's operations
 5. Necessary to ensure completion of the Work by the milestone and completion dates set forth in the Contract Documents
 6. Required in order for the Contractor to comply with the requirements of this Section or any other requirements of the Contract Documents
 7. Not in accordance with the Contractor's actual operations
- H. The electronic version of the schedule shall be submitted on a CD, in a form and format acceptable to the Engineer, including all required submission information resident in the computer system and containing all of the files associated with the schedule.
- I. Each week the Contractor will provide the Engineer and Public Information (PI) Office with a detailed two week look-ahead schedule. The schedule must be in the format required by the PI Office.

1.4 UPDATING OF THE SCHEDULE / PROGRESS REPORTS

- A. The Engineer shall review the Contractor's report of actual progress at each progress meeting. Prepared by the Contractor, said report shall set forth up-to-date and accurate progress. The Contractor in consultation with all principal subconsultants shall prepare said report. The Contractor will perform a complete schedule update on a monthly basis or at the discretion of the Engineer.
1. The Contractor shall submit the updated schedule in electronic format as directed by the Engineer. The Contractor shall submit hard copies of the schedule output including, but not limited to:
 - a. 30-day Look-ahead Report including but not limited to planned activities within the next thirty days
 - b. Milestones to be completed

2. The Contractor shall provide written explanation of all changes in activity durations, relationships, and constraints with the schedule output. Changes will require written approval by the Engineer.
- B. The Schedule Report of the Contractor shall show the activities, or portions of activities, completed during the reporting period, the actual start and finish dates for these activities, remaining duration and estimated completion dates for activities currently in progress.
 - C. At the progress meeting a total review of the Project will take place including but not limited to, the following:
 1. Current update of the Schedule of Record in format as prescribed by Engineer
 2. Anticipated detailed construction activities for the subsequent report period
 3. Critical items pending
 4. Contractor requested changes to the Schedule of Record
 - D. The Contractor shall submit a narrative with the progress report which shall include, but not be limited to, a narrative describing actual Work accomplished during the reporting period, a description of problem areas, current and anticipated delaying factors and their impact, explanations of corrective actions taken or planned, any proposed newly planned activities or changes in sequence, and proposed logic for a Recovery Schedule, if required, as further described herein.
 - E. No invoice for payment shall be submitted and no payment whatsoever will be made to the Contractor until the Schedule of Record, and narrative reports as defined herein, are updated.

1.5 SCHEDULE REVISIONS

- A. Should the Contractor desire to or be otherwise required under the Contract Documents to make modifications or changes in its method of operation, its sequence of Work or the duration of the activities in the Schedule of Record, it shall do so in accordance with the requirements of this Specification Section and the Contract Documents. The approved Schedule of Record may only be revised by written approval of the Engineer as provided herein.
- B. The Contractor shall submit requests for revisions to the Schedule of Record to the Engineer using the Schedule Revision Form provided by the Engineer. The Contractor shall identify revisions and description of logic for rescheduling work and substantiate that the milestone and completion dates will be met as listed in the Contract Documents. Proposed revisions acceptable to the Engineer and City will be

approved in writing and incorporated into the Schedule of Record.

- C. Requests for revision will be accompanied by evidence acceptable to the Engineer that the Contractor's subcontractors are in agreement with the proposed revisions.
- D. If there are separate consultants on the Project, the approval of the separate consultants shall be obtained to make the proposed schedule revisions. If accepted by the Engineer and City, the revisions shall be binding upon the Contractor and all separate consultants on the Project.
- E. The impact of all change orders to this Contract shall be included in the project schedule.

1.6 RECOVERY SCHEDULE

- A. Should the updated Schedule of Record, at any time during the Contractor's performance, show that, in the sole opinion of the Engineer, the Contractor is behind schedule for any milestone or completion date for any location or category of work, the Contractor, at the request of the Engineer, shall prepare a Schedule Revision for the purpose of displaying recovery. The revision shall identify how the Contractor intends to reschedule its Work in order to regain compliance with the Schedule of Record within thirty (30) calendar days.
- B. The Contractor shall prepare and submit to the Engineer a one month maximum duration Recovery Schedule, incorporating the best available information from subconsultants, subcontractors and others which will permit a return to the Schedule of Record at the earliest possible time. The Contractor shall prepare a Recovery Schedule to the same level of detail as the Schedule of Record. The Recovery Schedule shall be prepared in coordination with other separate consultants on the Project.
- C. Within two (2) calendar days after submission of the Recovery Schedule to the Engineer, the Contractor shall participate in a conference with the Engineer to review and evaluate the Recovery Schedule. Within two (2) calendar days of the conference, the Contractor shall submit the revisions necessitated by the review for the Engineer's review and acceptance. The Contractor shall use the accepted Recovery Schedule as its plan for returning to the Schedule of Record.
- D. The Contractor shall confer continuously with the Engineer to assess the effectiveness of the Recovery Schedule. As a result of these conferences, the Engineer will direct the Contractor as follows:
 - 5. If the Engineer determines the Contractor continues behind schedule, the Engineer will direct the Contractor to prepare a Schedule Revision and comply with all of the requirements of a Schedule Revision as stated herein and the other requirements of the Contract Documents; provided, however, that nothing herein shall limit in any way the rights and remedies of the City and Engineer as provided elsewhere in the Contract Documents; or

6. If the Engineer determines the Contractor has successfully complied with provisions of the Recovery Schedule, the Engineer will direct the Contractor to return to the use of the approved Schedule of Record.

1.7 FLOAT TIME

- A. Float or slack time shown on the currently approved Schedule of Record is not for exclusive use or benefit of either the City or the Contractor and is available for use by either of them according to whichever first needs the benefit of the float to facilitate the effective use of available resources and to minimize the impact of Project problems, delays, impact, acceleration or changes in the Work which may arise during performance. The Contractor specifically agrees that float time may be used by the City in conjunction with their review activities or to resolve Project problems. The Contractor agrees that there will be no basis for any modification of the milestone or completion dates or an extension of the Contract Time, or a claim for additional compensation as a result of any Project problem, delay, impact, acceleration, or change order which only results in the loss of available float on the currently approved Schedule of Record. Unless otherwise stated herein, float as referenced in these documents, is total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, that activity then becomes part of the critical path and controls the end date of the project. Thus, the delay of the non-critical path activity beyond its float period will cause delay to the project itself.
- B. Float time shown on the Schedule of Record shall not be used arbitrarily by the Contractor in a manner which, in the opinion of the Engineer, unnecessarily delays separate subcontractors from proceeding with their work in a way which is detrimental to the interests of the City. Liability for delay of the project completion date rests with the party actually causing delay to the project completion date. For example, if Party A uses some, but not all of the float time and Party B later uses the remainder of the float time as well as additional time beyond the float time, Party B shall be liable for the costs associated with the time that represents a delay to the project's completion date. Party A would not be responsible for any costs since it did not consume all of the float time and additional float time remained, therefore, the project's completion date was unaffected.

****END OF SECTION 01310****

SECTION 01320

CONSTRUCTION PHOTOGRAPHY

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall furnish all labor, equipment and materials required to provide the Owner with electronic construction photography of the Project as specified herein.
- B. The Contractor shall provide for professional videos and photographs to be made prior to and after construction to provide documentation of conditions and aid in any damage claims assessment. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.
- C. Video and photo files shall become the property of the Owner and none of the video or photographs herein shall be published without express permission of the Owner.
- D. Refer to Section 01350 for Project Document Tracking and Control System.

1.2 PRE AND POST CONSTRUCTION PHOTOGRAPHY

- A. Prior to the beginning of any work, the Contractor shall provide for professional videos for main line construction and photographs of the work area associated with the Work Order to record existing conditions.
 - 1. The Contractor shall furnish a complete videotaped record of the pipeline route or work area. The video shall include the date of taping and shall contain audio commentary to emphasize existing conditions along the entire route or work area.
 - 2. The work area or route shall be videotaped prior to beginning of construction. The Contractor shall furnish the file video data to the City's Authorized Representative in a medium and manner acceptable to the Owner.
 - 3. The work area or route shall also be videotaped at the completion of construction when directed by the City's Authorized Representative. The video shall show the same areas and features as in the preconstruction videos.
- B. The pre-construction videos shall be submitted to the City's Authorized Representative within 15 calendar days after receipt of construction Notice to Proceed by the Contractor. Post construction videos and photographs shall be provided prior to final acceptance of the project.
- C. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.

1.3 PROGRESS PHOTOGRAPHS

- A. Photographs shall be taken to record the general progress of the Project during each pay period.
- B. Photographs shall be representative of the primary work being performed at the time. All photographs shall be taken with a digital camera. The photographs shall include the date and time marking in the digital record. All photographs shall be labeled on a tab connected to the bottom of the photo to indicate date and description of work shown.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHS

- A. Photography and video files shall be provided in electronic format.
- B. Photographs shall also be provided in hard copy format. The photographs shall include the date and time marking on the photograph. All photographs shall be labeled on a tab connected to the bottom of the photograph. Tab label shall contain:
 - 1. Project name.
 - 2. Orientation of view.
 - 3. Description of work shown.
- C. All electronic formats furnished under this section shall be suitable for viewing with Windows Media Player.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. No construction shall start until pre-construction photography has been completed and accepted by the City's Authorized Representative with the exception of Emergency Work.
- B. Construction photographs shall be submitted with each payment request. Failure to include photographs may be cause for rejection of the payment request.
- C. The Contractor shall be responsible for all discrepancies not documented in the pre-construction videos and photography.

END OF SECTION 01320

SECTION 01350

PROJECT DOCUMENT TRACKING AND CONTROL SYSTEM

1.1 SCOPE

- A. The Contractor shall utilize City of Atlanta's Project Management System (e-Builder) for project document tracking and control. The primary function of the system is to facilitate timely processing and approval of all contract documentation in coordination with the overall Project Schedule established by these Specifications and the Contractor. e-Builder will utilize an internet application for document tracking and control and will provide the following benefits:
1. Facilitate communication among the Owner, Engineer and Contractor;
 2. Facilitate turn-around time with regard to responses and approvals;
 3. Facilitate processing of pay applications;
 4. Use for transmittal, processing and retention of submittals, RFI's, Change Notifications, daily logs, etc.
 5. Provide a central location for retention of Project information to facilitate all Project participants in performing their tasks based on the latest Project data;
 6. Provide a standard system of project administration with accountability.
- B. The Contractor shall be required to utilize the web-based application residing at <https://www.ebuilder.net> to generate documents in the proper format for submission to the City. The Contractor shall access e-Builder through the internet using a compatible web browser from the Contractor's administrative field office location, and/or other locations where work associated with the Project is being performed.
- C. The Contractor shall be required to generate Project documents and records utilizing the aforementioned system. The Contractor shall be required to transmit and submit the Project documents within the system to the City.
- D. The Contractor shall utilize a high capacity scanner capable of scanning document sizes up to 11" x 17", double sided, on site for the entire duration of the Project. All documents must be scanned and attached to the appropriate e-Builder document in the appropriate file.
- E. The Contractor shall utilize e-Builder to create and maintain Project documents, including, but not limited to the following:
1. Company Directory: Addresses, Phone Numbers, Personnel Contacts, etc.;
 2. Drawings Log: Current Drawing revision log;
 3. Submittals (Integrated with Project Schedule through Activity codes);
 4. Transmittals;
 5. Requests for Information and Answers (RFIs) ;

6. Change Documents, Including:
 - a. Work Authorizations (WAs);
 - b. Change Order Requests (CORs);
 - c. Change Orders (CO).
 7. Daily Reports (Daily Diaries);
 8. Field Decisions & Clarification Memos;
 9. Notice of Non-Compliance;
 10. Construction Issue Memos;
 11. Punch lists;
 12. Meeting Minutes & Agendas;
 13. Correspondence;
 14. Work Plans;
 15. Start-up Plans;
 16. Equipment Operation and Maintenance Training; and
 17. Spare Parts.
- F. The Contractor shall utilize the complete capabilities of e-Builder to meet requirements of this Section. The Contractor shall provide a highly trained and experienced construction project controls person knowledgeable in construction work sequencing, productivity, scheduling and application of e-Builder. This person, along with the Contractor's management team, shall work closely with the City to deliver the documents outlined in this Section.
- G. Software Support
1. The Contractor shall be required to establish an internet connection to connect to e-Builder to permit the forwarding and receipt of documents. Internet Explorer 10.1 or higher software is required.

The Contractor shall provide for two (2) days of consulting services in the base bid for setup configuration and troubleshooting e-Builder at any location designated by the City or at the Contractor's administrative field office (if authorized by the City). The Consultant utilized shall be approved by DWM in writing, based on a scope pre-defined by the City of Atlanta. The Contractor shall utilize the custom data fields, dictionaries, and coding systems as required by the City of Atlanta.
 2. The Contractor shall be required to attend a two (2)-day training session on the operation of e-Builder. The Contractor shall include in their base bid for five (5) participants to attend the training session. The Contractor shall be responsible for cost of training additional members of their firm or future retraining, as may be deemed necessary by the Contractor. An e-Builder trainer will be provided by the City.
 3. The Contractor shall meet with the City within five (5) days after the Contract is awarded to discuss access requirements and the Contractor's plan to utilize e-Builder and execute the document control functions herein.

The Contractor's e-Builder access shall be operational within ten (10) days following the Project's Notice to Proceed by the City.

1.2 COMPANY DIRECTORY

The Contractor and City will monitor and manage the company directory. The directory must include company name, company abbreviation, contact names, address, phone numbers and e-mail addresses.

1.3 DRAWING LOG

The City will maintain a log of initial "issued for construction" drawings in e-Builder. Information shall include drawing number, title and revision number. In addition to logging the initial project drawing list, the City will maintain a log on e-Builder of all subsequent revisions to these drawings and any sketches resulting from clarification memos, RFIs, field orders and Change Orders. It is the Contractor's responsibility to utilize the latest drawings and sketches in the performance of the Work.

1.4 SUBMITTALS/SHOP DRAWINGS

- A. Requirements: This section specifies supplemental requirements related to processing of submittals and shop drawings. The Contractor will utilize e-Builder to log and track submittals, as well as generate associated transmittal letters.
- B. Submittals & Product Data: A list of all required submittals will be entered into e-Builder by the Contractor. Submittals shall be incorporated into packages, with numbering to be provided by City's engineer. E-Builder will be used to log and track all submittals by the Contractor and document any reviews conducted by the City
- C. The Contractor shall identify as activities in the CPM schedule, specified in SC-16, to include all data submittals, as well as those involving complex reviews and long lead deliveries, and all procurement items required for construction activities. Submittal schedule information shall be updated monthly with the Contractor's updated project CPM schedule, as specified in SC-16. The updated monthly CPM schedule shall be uploaded as a pdf file into e-Builder and electronically transmitted to the City.
- D. Samples: A list of all required sample submittals will be entered into e-Builder by the Contractor. Sample submittals shall be identified as individual submittals within submittal packages with numbering as specified above.
- E. Guarantees/Warranties: A list of all required Guarantee/Warranty submittals will be entered into e-Builder by the Contractor. These submittals shall be identified as individual submittals within submittal packages with numbering as specified above.
- F. Work Plans, Start-up Plans, O&M Submittals and Spare Parts: All testing, Start-up and O&M submittals will be entered into e-Builder by the Contractor. These submittals

shall be identified as individual submittals within submittal packages identified with numbering as specified above.

- G. Submittal Procedures: The Contractor shall prepare all submittal packages utilizing the submittal numbering system, description and packaging conventions described above. Submittals prepared by the Contractor, which fail to follow the conventions described above, will be returned “amend and resubmit”. Should the Contractor determine a submittal is required but is not covered by the listing within e-Builder, consultation with the City to determine the submittal number, description and packaging will be required.

1.5 CORRESPONDENCE

The City shall monitor and manage project correspondence, Non-Compliance Notices, Field Decisions & Clarification Memos and Construction Issue Memo logs through e-Builder. The Contractor is responsible for generating project correspondence using a form in e-Builder to transmit information to the City.

1.6 TRANSMITTAL LOG

e-Builder will be used by the Contractor and City to monitor and manage transmittals. All Project transmittals shall be created electronically, automatically sequentially numbered and logged into e-Builder as they are created. The Contractor is responsible for utilizing e-Builder to create transmittals for items transmitted to the Owner, Engineer, Resident Inspection Staff and other Contractors.

1.7 REQUEST FOR INFORMATION & ANSWERS

The Contractor shall be responsible for generating RFIs using e-Builder. The Contractor shall notify the City when an RFI is submitted.

The City will use e-Builder to monitor and manage RFIs. The City will generate an Answer document in response to each RFI and transmit it to the Contractor through e-Builder. E-Builder will also be used to track “Ball in Court” for all RFIs and Answers, as well as date of original generation and response date.

e-Builder will be used to document the relative Specification Section and Drawings related to each RFI. e-Builder also will record the date of the request, the originator, responsible party for a response and the date of the response.

1.8 CHANGE DOCUMENTS NOT USED

1.9 DAILY REPORTS

The Contractor is responsible for creating daily reports (daily diaries) utilizing e-Builder. All daily Reports shall be entered into e-Builder by the Contractor by 10:00 a.m.

of the subsequent day the Contractor or any subcontractor performs work. e-Builder shall be used to transmit the reports to the City and archive the reports for future reference.

Required information for daily reports shall include Contractor, Date, Day, Temperature, Precipitation, Sky, Wind, Work Activity, Equipment, Field Force, Visitors, Materials, and Scheduled Activities utilizing the schedule activity codes. Daily reports which fail to link work activities to the active schedule will not be acceptable.

1.10 PUNCHLISTS

The City will create, monitor and manage punch lists using an e-Builder form. Punchlists will be transmitted to the Contractor electronically. The Contractor shall address Punch list items and forward updates to the City through e-Builder. Once accepted as complete, the City will access the punch list in e-Builder and close it out.

1.11 MEETING MINUTES AND AGENDA

The City shall monitor and manage the meeting minute process. The City will forward meeting minutes to the Contractor electronically. The City will log meeting minute items into the e-Builder within three (3) days of the meeting date.

1.12 PROGRESS PAYMENTS /REQUISITIONS FOR PAYMENT

The Contractor is responsible for creating progress payment applications directly within e-Builder software by 4:00 p.m. at the end of each update/billing period. The entire progress payment application will be submitted to the City electronically using e-Builder.

Four hardcopies of the original progress payment application cover sheet shall be printed and signed (in blue ink) by the Contractor. The Contractor will transmit the original signed cover sheets to the City within 2 days of completing each progress payment application.

The Contractor shall also simultaneously provide a separate submittal of the updated progress schedule (P6 or latest version at the time of purchase), as specified in SC-16. All Progress Payments and schedule of values shall be developed as defined in the Special Conditions.

Required information within the Pay Application shall be coordinated with the City's Project Manager. Maintenance of the "As Built" record documents by the Contractor shall be verified before processing will be approved. Failure of a Contractor to maintain project record documents, maintain current and properly prepared daily reports or to submit the project schedule update per SC-16 will be just cause for withholding of the monthly or final payment.

1.13 PHOTO MANAGEMENT

e-Builder software shall be utilized by the City and Contractor for duration of the project to document and maintain project photographs. The daily construction photographs will

be the permanent visual record of pre-construction conditions, daily construction site activities, and completion of construction work. The Contractor must submit to the City no less than four (4) record photos for each activity ID listed in the project schedule per the last schedule update. Applicable photos must accompany each Pay Application.

+++ END OF SECTION 01350 +++

SECTION 1351

PUBLIC RELATIONS AND COMMUNICATIONS

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide all personnel, services, and materials as specified under this Section necessary to meet the requirements and responsibilities related to the Public Involvement and Public Relations and Outreach as specified hereinafter, during performance of Work under the Agreement by the Contractor.
- B. Unless specifically stated otherwise within the Agreement, no separate payment will be made for satisfying Public Outreach requirements.

1.2 STAFFING

- 1.2.1 The City shall assign one (1) full time Public Information Officer (PIO) whose specific duties and job shall be to perform customer service-related functions and to continuously coordinate with the Contractor on the City's behalf to provide information and services as required by the City's Office of Communications and Community Relations and other City staff as necessary.
- 1.2.2 The City shall also designate a Public Information Manager (PIM) whose specific duties and job shall be to perform customer service-related functions and to continuously coordinate with the Contractor and PIO as necessary.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PUBLIC INFORMATION KICK-OFF MEETING

Prior to commencement of Work under the Agreement and following the Preconstruction Meeting, the Contractor, the Project Manager (PM), Construction Manager (CM), Public Information Manager (PIM), Public Information Officer (PIO), and the City's Engineer will be required to attend a public information meeting hosted by the DWM Office of Communications and Community Relations. At this meeting the Contractor's responsibilities will be discussed,

the relationship with the OCCR, the City's Engineer and/or designated representative of the City. The Contractor and staff will also be advised as to the expectations of the City regarding citizen relations and inquiries, as well as public notification protocols.

3.2 DOOR-HANGERS

- A. The Contractor shall produce door hangers required for notice to customers/citizens and residents from the template provided by the City's PIM as specified hereinabove in paragraph 3.02. Door hangers shall be utilized for notification in the event of, but not limited to, the following events:
 - 1. Planned service disruption/outages
 - 2. Road closures/detours/traffic pattern changes
 - 3. Access/entrance to property
 - 4. Work start-up
 - 5. CCTV
 - 6. Smoke Testing
 - 7. Dye Testing

3.3 IMPACTED AREA ADDRESS DATABASE

- A. The Contractor shall provide the Office of Communications and Community Relations with a database of addresses and phone numbers (and names if available) of all project impacted residences, businesses and facilities at least three (3) weeks prior to project start-up. The database will be used by the City's PIO for regular citizen communications and notifications.
- B. The Contractor and Engineer shall copy the City's PIO on all correspondence with citizens and property owners.

3.4 CUSTOMER SERVICE TRACKING SOFTWARE

- A. The Contractor shall use the City's Project Management Software to track and enter information from customers/citizens regarding complaints, claims and inquiries. All related information shall be updated on a daily basis. Tracking information and responses shall be coordinated with the City's PIO. Reports shall be provided as weekly updates on all activities and on specific cases within twenty-four (24) hours when requested.

- B. Information recorded shall include but not be limited to the following:
1. Date complaint/claim/inquiry received.
 2. Name, address and telephone number of individual filing complaint/claim/inquiry.
 3. Nature of complaint/claim/inquiry.
 4. Address where problem is located if different than above.
 5. Action required, date, action taken, date action completed.
 6. Follow-up with person who filed under 2 above to verify satisfaction or status.
 7. Documents associated with actions taken.
 8. Any information regarding resolution with the Contractor's, Subcontractor's or Vendor's Insurance Company shall be fully documented.

3.5 IDENTIFICATION BADGES AND SECURITY

- A. All members of the Contractor's staff and his subcontractor's permanent staff at or above the level of foreman who will be working on-site will be issued an ID badge by the City. The ID badge will list the worker's name and company Affiliation and will include a picture.
- B. A template will be provided by the PIM and shall be returned to the Office of Security and Safety when updated with the above information for signature by the Director of Security and Safety.
- C. It shall be the Contractor's responsibility to collect the ID badges from any employee who is discharged or resigns prior to completion of the project as well as at completion of the project. The Contractor shall return all ID badges to the Office of Security and Safety within 48 hours of their collection. The Contractor will be charged a fee of \$25.00 per badge for any badge not returned at completion of the project. For any ID badges lost during the term of the project that must be reissued, there will be a charge of \$15.00 per ID badge. The Contractor shall deduct these charges from his periodic or closeout payment request or the City will deduct.
- D. Since lower-level personnel of the Contractor, Subcontractor or Vendor will not be issued ID badges, the Contractor must maintain a daily sign-in sheet for daily workers under his supervision. The Superintendent must be able to identify any employee on the site as a bona fide worker if asked and if not able to identify, the Engineer will direct the Superintendent to remove

the individual from the site. The Contractor and Subs or Vendors will provide a program of temporary ID badges and/or laminated on-site passes that must be cross-referenced to each day's employee timecard/payroll sheet with unique employees' numbers. Any employee that will be on the Project over thirty (30) days will be issued a picture ID with the employee number prominently shown. Any employee possessing an ID badge must wear that badge visibly at all times on the Project. The Contractor is responsible for maintaining a safe "drug-free" work environment.

- E. The Contractor shall develop a Security Plan for use on the job site during construction. The Plan shall encompass as a minimum such topics as the use of pre-employment background checks for specific project staff, drug tests, crime prevention and anti-theft procedures, workplace violence and methods to secure project documents. All staff working on the site shall be familiar with the requirements of the Security Plan.
- F. City Ordinances prohibit the carrying of weapons on City streets. The City of Atlanta Police Department will be notified of any person bringing weapons to the jobsite; they will be removed immediately and prosecuted.
- G. All of the Contractor's staff at or above the level of foreman shall attend a 4-hour mandatory CMG Security Training session conducted by the Office of Security and Safety. Multiple training sessions will be offered, and staff must complete the training at least within 1 month of commencing work on the jobsite. All costs associated with the training will be considered as incidental to the Contract.
- H. Persons on the jobsite shall report any suspicious activity by workers or by others at the jobsite area first to the Project Management, and/or Atlanta Police Department by calling 911 and immediately to the Director of Security and Safety.
- I. Non-invasive temperature screenings will be conducted prior to allowing access to the jobsite. Screening includes:
 - Answering questions about symptoms prior to entering worksite
 - Temperature check

Results of any screenings will be confidential and will only be recorded in the event the individual is denied entry into the job site.

3.6 SCHEDULE

- A. The Contractor shall provide the City's PIO with a copy of the detailed project schedule following approval by the Engineer.
- B. Bi-weekly, the Contractor shall provide a list of properties:

1. That will be affected by the Contractor's activities within the upcoming 4 weeks;
 2. Where work is ongoing in the right of way in front or in the back of the property;
 3. Where site restoration activities are ongoing.
- C. The Contractor shall inform the City's PIO through the weekly progress meetings and in writing of any project schedule changes or changes in "disruptive work" such as blasting, road closures, etc., that would have significant impact on citizens or require prior citizen notification. The Contractor shall notify the City's PIO of any "disruptive" activities affecting the public that occur on the jobsite within 4 hours of their occurrence.

3.7 MAPS

The Contractor will provide the assigned City's PIO with a map of each project area assigned by task order, including the proposed and existing sewer overlays. The map will include property lines and addresses, so the Contractor can identify the areas of impacted properties.

3.8 MEDIA RELATIONS AND JOB SITE INQUIRIES

- A. As specified above in paragraph 3.01, only authorized persons shall release any information to media inquiries. The Contractor's field personnel shall at all times have project information cards available that will be provided to media and citizens if inquiries are made on-site. All inquiries shall be directed to the person referred to on the card and citizens shall be referred to the DWM Project Hotline telephone number (404-546-3200) and the www.Atlantawatershed.org website
- B. Project information cards shall be produced by the Contractor from the template provided by the DWM Office of Communications and Community Relations. Final language to be included on the Project Information Card will be provided.

3.9 TRAINING

- 3.9.1 All of the Contractor's staff at or below the level of superintendent shall attend a mandatory Public Relations Training and Protocol Procedures Training. The purpose of this training is to teach construction crews on how to deal with citizens, the media, etc. and how to conduct themselves on the jobsite. This training is approximately one (1) hour in length and will be facilitated by City

staff at a designated City facility. Training will be provided at no cost to the Contractor.

3.10 VEHICLES SIGNS & PROJECT SITE SIGNAGE

- A. The Contractor shall place the COA logo, project name, help line number, and website address on all magnetic vehicle signs as specified in Specification Section 10440, Signs and Identifying Devices. Vehicle signs shall be installed on all vehicles used for Work on this project. A signage template will be provided by the DWM Office of Communications and Community Relations and produced by the Contractor.
- B. Note: The cost for the production, installation and maintenance of the signs will be paid for through the respective unit price bid items, in accordance with specification Section 10440.
- C. All project sites shall have pre-approved project signs which read in accordance with the Template provided as part of the Special Conditions. Signs shall be produced by the Contractor. Some of the signs shall be mounted on moveable skids so they can be relocated as the project progresses on various streets in the basin. Sizes will vary, but all will be smaller than the 96"x 48" size project signs shown. Size shall be as directed by the Engineer. Contractor shall provide a minimum of 25 project signs. These signs are required in addition to the four City of Atlanta Project signs identified in the Special Conditions.

3.10.1 NOTIFICATIONS

- A. The Contractor shall provide the following notifications to the City's PIO and the City's PIM to facilitate communication to affected citizens through automated phone message or mailers:
 - 1. Anticipated work start date-must be three (3) weeks prior so the City's PIO may send out two (2) week notice mailer.
 - 2. Service disruptions-notify the City's PIO at least 72 hours in advance so that 48-hour notice automated phone message notice may be issued.
 - 3. Street Closure or Partial Closure-notify the City's PIO at least 72 hours in advance to permit 48-hour automated phone message.
 - 4. Significant work in neighborhood- blasting, directional drilling, trenchless installation, smoke testing, dye testing, open cut, etc.-notify the City's PIO at least 72 hours in advance to permit 48-hour automated phone message.

- B. The Contractor shall provide the following door hanger notifications and the manpower to deliver them at a minimum:
 - 1. Service disruptions- notice to citizens 24 hours prior to disruption.
 - 2. Street Closure or Partial Closure - notify fire, police other emergency services and other authorities 24 hours prior to street closure.
 - 3. Significant work in neighborhood- blasting, directional drilling, trenchless installation, open cut, etc.-notify citizens via door hangers 24 hours in advance.
- C. The Contractor shall be fully responsible for notification to all emergency related services for detours, closures (partial or full) or traffic pattern changes and as such they must be detailed in their traffic control plan and implemented through the Contractor's Traffic Control Manager and per all permitting requirements.
- D. The Contractor shall be fully responsible for distributing all notifications a minimum of 48 hours in advance of service outages for schools, nursing homes, hospitals, medical clinics, assisted living facilities or other types of facilities. Contractor shall also make personal contact with facility representatives no later than 60 minutes prior to the outage.
- E. The Contractor shall at all times coordinate with the City's Office of Communications and Community Relations and Call Center to provide detailed schedules and street locations for service disruptions or street closures to ensure that Call Center is well equipped to provide adequate response to citizen inquiries.

3.10.2 RESPONSES AND RESOLUTION OF CITIZEN INQUIRIES

- A. Customer Service Tracking Software: The Contractor shall use the City's Project Management Software to enter status information and track inquiries related to the project. The City Call Center attendant shall create the initial file and enter information for resident and property owner complaints and/or claims. This information shall be updated on daily bases. Tracking information and responses shall be coordinated with the Contractor and City's PIO.
- B. When a City of Atlanta's Call Center attendant informs the Contractor of a citizen inquiry or complaint, the Contractor shall respond immediately to the call center if the inquiry is related to an emergency situation. If the inquiry is general, the contractor's response is required within 24 hours to the call center with an update on the resolution status. The citizen's name date and time of call and complaint shall be documented and tracked by the

Contractor using the City's Project Management Software database, which will assign a complaint tracking number. The complaint information will be transmitted to the Contractor and PIO within 24 to 48 hours. The citizen will receive a follow-up call from the call center with the status information on the resolution of the problem within 24 hours, and additional follow-up calls until the problem is resolved.

- C. Unresolved inquiries will be reviewed at project progress meetings. At this time, the City's PIO will review open inquiries and the Contractor's Representative will facilitate follow-up on resolution.

3.10.3 RESOLUTION OF COMPLAINTS AND CLAIMS

Failure of the Contractor to resolve any legitimate complaint or claim filed resulting from the work performed under this contract, following notice in accordance with the contract agreement, may result in resolution of the complaint or claim by the City. The Contractor will be charged for the associated cost in accordance with the applicable sections of the contract. No additional payment will be made to the Contractor for any costs associated with complaint or claim resolution, same being incidental to the various contract items which are bid. Failure to manage the issues and items adequately to minimize public complaints and impacts will be cause for increasing the retainage, withholding payment and/or Notice and Termination of the Contractor cause if more than 10% of the noticed complaints or claims age past 30 days without decisive resolution and scheduling of recovery work.

3.10.4 PROJECT UPDATES

The Contractor will provide monthly project updates regarding significant progress, notable changes, and any consent decree milestones to be used by the DWM Office of Communications and Community Relations staff to update the Atlantawatershed.org website, project materials, monthly and quarterly reports.

3.10.5 RIGHTS OF ENTRY AND ACCESS TO PRIVATE PROPERTY

- A. The Contractor is required to coordinate with the Office of Engineering Services Land and Easement Group regarding any agreements with the property owner(s) to access or work outside of the City's existing easements or rights of way or any agreements related to property restoration, as may be necessary for the Work or at the convenience of the Contractor. Such coordination shall include the following:

1. Maintaining a contact log with, but not limited to, all: contact names, addresses and phone numbers; all attempts (with date, name, and notes of conversation) via telephone, in person, or via written correspondence. The Contractor must maintain copies of all written correspondence with the property owner(s) and/or tenant(s), and provide the City with Copies, if directed by the City or already required as part of this Section;
 2. Assuming responsibility relating to the private property access and any agreements reached between the Contractor and the Property Owner;
 3. Taking any other steps as reasonably necessary to adequately protect the interests of Contractor, the private property owner and the City with respect to the accessing the City's existing easement areas;
- B. The Contractor is required to work within the City's existing easement areas and rights of way at all times; however, at the Contractor's convenience and if agreed upon between the Contractor and the Property Owner the Contractor may follow a route other than along the City's right of way alignment. In such case, the Contractor must have a written agreement with the Property Owner to document the terms and conditions of the Work and/or property restoration, which shall be subject to the City's review and approval. Any such agreement shall be at the Contractor's expense.
- C. The Contractor must identify all parcels requiring access or Work associated with the project, including parcels owned by: CSX, Norfolk Southern, Georgia Power, Fulton County, DeKalb County, Atlanta Housing Authority, MARTA, Schools, or City owned parcels under the purview of another department, within the first 30 days after the NTP has been officially delivered to the Contractor. Permits and agreements with such property owners to perform Work may be required as a condition of commencement of Work on properties owned by such entities. As such, Contractor shall cooperate with the City to negotiate and enter into appropriate agreements with such property owners to prior to commencement of Work in a form acceptable to the City.
- D. The Contractor must identify all areas where the Contractor believes it is physically impossible to perform the work in the existing easement area within the first 30 days after the NTP has been officially delivered to the Contractor. If any such area exists, the Contractor must state in writing the property information (address and tax PIN), the work to be performed, and the reason they believe it is impossible to work within the easement area. If the City deems it is impossible to perform the work in the City's existing easement area and/or rights of way, the City will proceed with the acquisition of required temporary construction easement or other interests

necessary to perform the Work. The City will make the ultimate decision regarding the ability or inability of the work to be performed within the existing easement area and shall provide such determinations in writing to the Contractor. In the instances for which formal acquisition processes must occur, Contractor shall take all available steps to prioritize work in other areas to avoid delays in overall project work. The City shall not be responsible for unapproved damage to private properties or deviations from the rights of way and/or easement areas for the convenience of the Contractor.

- E. Contractor must, in all dealings with private property owners concerning this type of access to their property, advise that the Contractor is an independent contractor and is not seeking or obtaining access to private property on behalf of the City. Contractor must include this advisement in all written communications with any private property owner, as well as all documents evidencing or relating to agreed access to private property. Contractor may at any time during the course of performing the Work request clarification of the City's existing easements and/or rights of way through an RFI process.

ATTACHMENT A
Citizens Comments Response

PROJECT #

PROJECT NAME:

Basic Data

Contact ID:

First Name	Last Name	Council District / NPU		
Number	Street Name	St, Ave, etc.	Apt. #	Zip
Address				
Home Phone		Work Phone		
Email :		Outside Project Area		
Notes:				

Comments / Complaints / Request

Comment Date	Engineer needs
Comment / Complaint:	

Response

Response Date	Is Follow-up Required
Who Responded	
Response Given:	

SECTION 01410

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SCOPE

- A. From time to time during progress of the Work, the Engineer may require that testing be performed to determine that materials provided for the Work meet the specified requirements, in accordance with the requirements of the Specifications. Such testing includes, but is not necessarily limited to:
 - 1. Cement
 - 2. Aggregate
 - 3. Concrete
 - 4. Concrete block
 - 5. Pipe
 - 6. Steel and metals
 - 7. Welding
 - 8. Soil compaction
 - 9. Bituminous pavement
- B. Requirements for testing may be described in various sections of these Specifications; where no testing requirements are described but the Engineer decides that testing is required to demonstrate compliance with specified material or performance standards, the Engineer may require testing to be performed under current pertinent standards for testing.
- C. Employment of a testing laboratory shall in no way relieve the Contractor of Contractor's obligation to perform work meeting the requirements of the Contract.
- D. The independent testing laboratory shall be selected and paid by the Contractor and approved in writing by the Engineer before any testing services are performed.
- E. The Contractor shall pay directly for the services of the independent testing laboratory, approved by the Engineer, for all testing required under this Contract.

1.2 LABORATORY DUTIES

- A. Cooperate with Engineer and Contractor.
- B. Provide qualified personnel promptly on notice.

- C. Perform specified inspections, sampling and testing of materials and methods of construction.
 - 1. Comply with specified standards, ASTM, other recognized authorities and as specified.
 - 2. Ascertain compliance with requirements of Contract Documents.
- D. Promptly notify Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.
- E. Promptly submit three (3) copies (two (2) copies to Engineer and one (1) copy to Contractor) of report of inspections and tests in addition to those additional copies required by the Contractor including:
 - 1. Date issued
 - 2. Project title and number
 - 3. Testing laboratory name and address
 - 4. Name and signature of inspector
 - 5. Date of inspection or sampling
 - 6. Record of temperature and weather
 - 7. Date of test
 - 8. Identification of product and Specification section
 - 9. Location of Project
 - 10. Type of inspection or test
 - 11. Results of test
 - 12. Observations regarding compliance with Contract Documents
- F. Perform additional services as required.
- G. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of Work.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to Work and/or manufacturer's requirements.
- B. Provide to laboratory, preliminary representative samples, in required quantities, of materials to be tested.
- C. Furnish copies of mill test reports.
- D. Furnish required labor and facilities.
 - 1. To provide access to Work to be tested
 - 2. To obtain and handle samples at the site
 - 3. To facilitate inspections and tests
 - 4. Build or furnish a holding box for concrete cylinders or other samples as required by the laboratory.

- E. Notify laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.
- F. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample or samples shall be selected by such laboratory or agency or the Engineer and shipped to the laboratory by the Contractor at Contractor's expense.
- G. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Engineer.

1.4 QUALITY ASSURANCE

Testing, when required, will be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).

1.5 PRODUCT HANDLING

Promptly process and distribute all required copies of test reports and related instructions to insure all necessary retesting or replacement of materials with the least possible delay in progress of the Work.

1.6 FURNISHING MATERIALS

The Contractor shall be responsible for furnishing all materials necessary for testing.

1.7 CODE COMPLIANCE TESTING

Inspections and tests required by codes or ordinances or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1.8 CONTRACTOR'S CONVENIENCE TESTING

Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

1.9 SCHEDULES FOR TESTING

A. Establishing Schedule

1. The Contractor shall, by advance discussion with the testing laboratory determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.

2. Provide all required time within the construction schedule.
- B. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.

1.10 TEST AND CERTIFICATIONS

- A. General: As a minimum, the following tests shall be performed and the following certifications provided:
1. Cement: Certified test results by cement manufacturer or by independent laboratory shall be furnished as required by the Engineer.
 2. Aggregate and Mortar Sand: Certified test results by aggregate producer or by independent laboratory shall be furnished as required by the Engineer.
 3. Concrete
 - a. At least five (5) standard 6 inch cylinders shall be taken each day for each 100 cubic yard or fraction thereof for each class of concrete used.
 - b. The number of cylinders, the point of sampling, and the method of securing the samples shall be determined by the Engineer.
 - c. The five (5) samples shall be taken to the testing laboratory for laboratory curing.
 - d. Two (2) of the laboratory cured samples shall be tested at 7 days, two (2) samples tested at 28 days; one (1) sample in reserve.
 - e. Test all concrete in accordance with ASTM C31 69, C39 71 and C 172.
 - f. Slump Tests
 - 1) Perform slump tests on the job in accordance with ASTM standards.
 - 2) One (1) slump test shall be performed for each 25 cubic yards of concrete.
 - 3) More slump tests shall be performed if deemed necessary by the Engineer.
 - g. Perform air entrainment tests in accordance with the following standards:
 - 1) Field tests ASTM C 173
 - 2) Laboratory tests ASTM C 231
- B. Precast and Concrete Block for Buildings
1. Block and precast may be visually inspected on the site by the Engineer.
 2. The Engineer reserves the right to have the concrete block tested by an independent laboratory.

- C. Steel and Miscellaneous Metal: Reinforcing steel, structural steel and miscellaneous metal may be inspected visually on the site by the Engineer.
- D. Welding: 1 percent of all structural welds during construction shall be inspected either visually or by an independent laboratory as required by the Engineer.
- E. Compaction of Earthwork
 - 1. The compaction shall be tested by the Engineer or by an independent laboratory.
 - 2. The testing shall be performed in a manner in accordance with these Specifications.
- F. Bituminous Concrete: The material testing for the bituminous concrete shall be performed by an independent laboratory as deemed necessary by the Engineer.

1.11 TAKING SPECIMENS

Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the testing laboratory or the Engineer.

1.12 TRANSPORTING SAMPLES

The Contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

+++ END OF SECTION +++

SECTION 01416

SPECIAL INSPECTIONS AND PROCEDURES

PART 1 – GENERAL

1.1 SCOPE

- A. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals as shown, specified, and required to cooperate with the coordinating special inspector, individual special inspectors, and testing agencies employed by owner, to facilitate special inspections.
- B. Supplement A, Statement of Special Inspections, included with this Section, lists testing and inspections required.

1.2 DEFINITIONS

- A. Coordinating Special Inspector: Professional engineer or architect, hired by OWNER, registered in the same state as the Site, responsible for coordinating and verifying the inspection and testing required by the Statement of Special Inspections included in this Section and reporting to the Building Official.
- B. Building Official: Officer or other designated authority having jurisdiction charged with the administration and enforcement of the governing building code, or a duly authorized representative.
- C. Special Inspections: Testing and inspection required in Supplement A, Statement of Special Inspections, of this Section.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. OWNER will employ and pay for services of the Coordinating Special Inspector, who will have not less than five years of experience in managing, monitoring, and inspecting building construction.
 - 2. Inspectors will be qualified in the responsibilities of the Special Inspection for which each is responsible.
- B. Regulatory Requirements:
 - 1. Special Inspections will be in accordance with applicable building code and other Laws and Regulations, and

Supplement A, Statement of Special Inspections, of this Section.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Samples: Representative Samples of materials when required by ENGINEER.
- B. Informational Submittals: Submit the following:
 - 1. Completed Supplement C, Contractor's Statement of Responsibility, as attached to this Section, addressing each system and component listed in the Quality Assurance Plan portion of Supplement A, Statement of Special Inspections, of this Section.
 - 2. Completed Supplement D, Fabricator's Certificate of Compliance, as attached to this Section, for fabrication of structural steel.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Prepare Supplement C, Contractor's Statement of Responsibility, of this Section which shall include:
 - 1. Acknowledgment of the requirements of the Quality Assurance Plan portion of Supplement A, Statement of Special Inspections, of this Section.
 - 2. Acknowledgment that necessary quality control shall be exercised in fabricating, handling, and installing, to comply with the Contract Documents.
 - 3. List CONTRACTOR's procedures for ensuring the quality of the Work necessary for compliance with the Contract Documents relative to each system or component listed in the Quality Assurance Plan portion of Supplement A of this Section.
 - 4. List personnel who control the quality of the Work relative to the Contract Documents and indicate their position in the CONTRACTOR's organization.
- B. Provide safe access to the Work to be tested and inspected.
- C. Provide assistance in obtaining and handling test samples at the Site.
- D. Facilitate inspections and tests.
- E. Provide access to Suppliers' and Subcontractors' operations as required.

- F. Notify Coordinating Special Inspector and ENGINEER sufficiently in advance of the Work for the Coordinating Special Inspector and ENGINEER to coordinate their personnel at the Site. Do not cover the Work to be inspected until Special Inspection has been completed and the results thereof are acceptable.
- G. Special Inspections required in this Section do not supersede or make unnecessary inspections and tests required under other Specification Sections or standard inspections required by Laws and Regulations.

1.6 COORDINATING SPECIAL INSPECTOR'S RESPONSIBILITIES

- A. Complete Supplement A, Statement of Special Inspections, of this section to provide names of each inspector and testing agency for each Special Inspection required.
- B. Engage services of inspectors and testing agencies for Special Inspections in accordance with Supplement A, Statement of Special Inspections, of this Section and as required by Laws and Regulations.
- C. Coordinate activities of individual inspectors and testing agencies with CONTRACTOR.
- D. Provide interim reports of inspections and material testing to Building Official, OWNER, and ENGINEER.
- E. To obtain certificate of use and occupancy from the Building Official, complete and provide to the Building Official, OWNER, and ENGINEER Supplement B, Final Report of Special Inspections, of this Section, documenting completion of Special Inspections and correction of discrepancies noted in the Special Inspections.

1.7 INSPECTOR RESPONSIBILITIES

- A. Perform specified inspections, sampling, and testing of materials and methods of construction; review and ascertain compliance with Laws and Regulations.
- B. Promptly notify Coordinating Special Inspector, OWNER, ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work observed during Special Inspections. Corrective action, if required, will be determined by ENGINEER.

- C. Promptly submit two copies of each report of inspections and tests to Coordinating Special Inspector, ENGINEER, and CONTRACTOR including:
1. Date issued.
 2. Project title and number.
 3. Name and signature of inspector.
 4. Date of inspection or sampling and test.
 5. Record of temperature and weather.
 6. Identification of product and Specification Section.
 7. Location in Project.
 8. Type of inspection or test.
 9. Results of inspections and tests, and observations regarding compliance with Laws and Regulations, and standards.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

The supplements listed below, following the “End of Section” designation, are part of this Section:

- A. Supplement A – Statement of Special Inspections
- B. Supplement B – Final Report of Special Inspections
- C. Supplement C – Contractor’s Statement of Responsibility
- D. Supplement D – Fabricator’s Certificate of Compliance

+++ END OF SECTION +++

Supplement A - Statement of Special Inspections

Project:

Location:

Owner:

Design Professional in Responsible Charge:

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to the Project as well as the name of the Coordinating Special Inspector and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompass the following disciplines:

☐ Structural ☐ Mechanical/Electrical
☐ Architectural ☐ Other: _____

The Coordinating Special Inspector shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Inspections listed are periodic unless indicated to be continuous or required by code to be continuous.

Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: Weekly

or ☐ per attached schedule.

Prepared by:

(type or print name)

Signature

Date

Design Professional Seal

Owner's Authorization:

Building Official's Acceptance:

Signature

Date

Signature

Date

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Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

☐ Soils and Foundations	☐ Spray Fire Resistant Material
☐ Cast-in-Place Concrete	☐ Wood Construction
☐ Precast Concrete	☐ Exterior Insulation and Finish System
☐ Masonry	☐ Mechanical & Electrical Systems
☐ Structural Steel	☐ Architectural Systems
☐ Cold-Formed Steel Framing	☐ Special Cases

Quality Assurance Plan

Quality Assurance for Seismic Resistance

Seismic Design Category D for River, B elsewhere

Quality Assurance Plan Required (Y)

Description of seismic force resisting system and designated seismic systems:

- Ordinary concentric braced steel frames transferring lateral load to ordinary reinforced concrete shear walls.
- Seismic system installation of piping containing combustible or hazardous materials or piping where failure could damage the fire sprinkler system or other piping or equipment containing combustible or hazardous materials
- Seismic system installation of Mechanical and Process equipment containing combustible or hazardous materials
- Seismic system installation of mechanical and electrical system components located where support failure could damage piping or equipment containing combustible or hazardous materials or the fire sprinkler system
- Seismic system installation of tanks containing hazardous materials

Quality Assurance for Wind Requirements

Basic Wind Speed (three-second gust)

Wind Exposure Category C

Quality Assurance Plan Required (N)

Description of wind force resisting system and designated wind resisting components:

Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspections are subject to the approval of the Building Official. The credentials of all inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When Engineer deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.

International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Exterior Design Institute (EDI) Certification

EDI-EIFS	EIFS Third Party Inspector

Other

Soils and Foundations

Item	Agency #	Scope
1. Excavations	PE/GE	<i>Verify excavations are extended to proper depth and have reached proper material (periodic).</i>
2. Shallow Foundations	PE/GE	<i>Inspect subgrade below footings for adequate bearing capacity and consistency with geotechnical report (periodic).</i> <i>Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill</i>
3. Compacted Fill	PE/GE	<i>Perform classification and testing of compacted fill materials (periodic).</i> <i>Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill (continuous).</i> <i>Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly (periodic).</i> <i>Verify extent and slope of fill placement.</i>
4. Driven Deep Foundations	PE/GE	<i>Verify element materials, sizes and lengths comply with requirements.</i> <i>Determine capacities of test elements and conduct additional load tests, if required.</i> <i>Observe driving operations and maintain complete and accurate records for each element.</i> <i>Verify placement location and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations, and document any damage to foundation element.</i> <i>For steel elements, perform additional inspections required for Structural Steel.</i> <i>For concrete elements and concrete-filled elements, perform additional inspections for cast-in-place concrete.</i>
5. Cast-in-Place Deep Foundations	PE/GE	<i>Observe drilling operations and maintain complete and accurate records for each element.</i> <i>Verify placement location and plumbness, confirm element diameters, confirm bell diameters (if applicable), lengths, embedment into bedrock (if applicable), and adequate end bearing strata capacity. Record concrete or grout volumes.</i> <i>For concrete elements, perform additional inspections for cast-in-place concrete.</i>
6. Other:		

Cast-in-Place Concrete

Item	Agency # (Qualif.)	Scope
1. Mix Design	ACI-CCI ICC-RCSI	<i>Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.</i>
2. Material Certification	PE/SE	<i>Review trial batch or supporting test data to verify mix meets specified requirements. Confirm materials meet specified requirements.</i>
3. Reinforcement Installation	ACI-CCI ICC-RCSI	<i>Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters</i>
4. Formwork Geometry		<i>Inspect formwork for proper dimensions and alignment.</i>
5. Welding of Reinforcing	AWS-CWI	<i>Visually inspect all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect preheating of steel when required.</i>
6. Anchor Rods	ACI-CCI ICC-RCSI	<i>Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors. (continuous)</i>
7. Concrete Placement	ACI-CCI ICC-RCSI	<i>Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated. (continuous)</i>
8. Sampling and Testing of Concrete	ACI-CFTT ACI-STT	<i>Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231) and temperature (ASTM C1064).</i>
9. Curing and Protection	ACI-CCI ICC-RCSI	<i>Inspect curing, cold weather protection and hot weather protection procedures.</i>
10. Other:		

Masonry

Required Inspection Level: ☐ 1 ☒ 2

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Item	Agency # (Qualif.)	Scope
1. Material Certification	PE/SE	- Confirm size and strength of masonry units. - Confirm grout mix design and materials. - Confirm mortar mix design and materials
2. Mixing of Mortar and Grout	ICC-SMSI	Inspect proportioning, mixing and retempering of mortar and grout. (continuous)
3. Installation of Masonry	ICC-SMSI	Inspect size, layout, bonding and placement of masonry units.
4. Mortar Joints	ICC-SMSI	Inspect construction of mortar joints including tooling and filling of head joints.
5. Reinforcement Installation	ICC-SMSI AWS-CWI	- Inspect placement, positioning and lapping of reinforcing steel. - Inspect welding of reinforcing steel. (continuous)
6. Grouting Operations	ICC-SMSI	- Inspect that masonry cells are clear of debris prior to grouting. - Inspect placement and consolidation of grout. (continuous)
7. Weather Protection	ICC-SMSI	Inspect cold weather protection and hot weather protection procedures. Verify that wall cavities are protected against precipitation.
8. Evaluation of Masonry Strength	ICC-SMSI	Test compressive strength of mortar and grout cube samples (ASTM C780).
9. Anchors and Ties	ICC-SMSI	Inspect size, location, spacing and embedment of dowels, anchors and ties.
10. Other:		

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures ☐ Fabricator Exempt	PE/SE AWS/AIS C-SSI ICC-SWSI	- Verify fabricator has certification from AISC for conventional buildings of the AISC Quality Certification Program and has approval by the Building Official. - Review fabricator's certificate of compliance.
2. Material Certification	AWS/AIS C-SSI ICC-SWSI	Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts and welding electrodes
3. Bolting	AWS/AIS C-SSI ICC-SWSI	Inspect installation and tightening of high-strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip-critical connections.
4. Welding	AWS-CWI ASNT	- Visually inspect all welds. Inspect pre-heat, post-heat and surface preparation between passes. Verify size and length of fillet welds. (continuous for all field welds) - Ultrasonic testing of all partial and full-penetration welds.
5. Shear Connectors	AWS/AIS C-SSI ICC-SWSI	Inspect size, number, positioning and welding of shear connectors. Inspect studs for full 360 degree flash. Ring test all shear connectors with a 3 lb hammer. Bend test all questionable studs to 15 degrees.
6. Structural Details	PE/SE	Inspect steel frame for compliance with structural drawings, including bracing, member configuration and connection details.
7. Metal Deck	PE/SE AWS-CWI	- Review manufacturer's certificate of compliance with ASTM standards specified. Verify decking section profile, gage, and properties conform to contract documents. - Inspect welding and side-lap fastening of metal roof and floor deck.
8. Other:		

Anchor Systems

Item	Agency # (Qualif.)	Scope
1. Material Certification	PE/SE	- Confirm anchor type (including product name), anchor dimensions, and anchor material grade for each anchor application. - Confirm post-installed anchor compliance with specified requirements and suitability for each application type by review of the anchor system ICC-ES Evaluation Service Report. - For adhesive anchors, confirm adhesive type
2. Installation of Adhesive Anchors for Concrete, Grout-filled Masonry, and Hollow Concrete Masonry	ICC-RCSI ICC-SMSI	- Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report. - Verify and record anchor type (including product name), anchor dimensions, anchor material grade, adhesive type, adhesive expiration date, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment, curing period prior to tightening, and tightening torque. - Inspect installation of each type and size of adhesive anchor by construction personnel on the site. (continuous)
3. Installation of Concrete and Grout-filled Masonry Wedge Expansion Anchors	ICC-RCSI ICC-SMSI	- Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report. - Verify and record anchor type (including product name), anchor dimensions, anchor material grade, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment and tightening torque. - Inspect installation of each type and size of wedge anchor by construction personnel on the site. (continuous)
4. Anchor Testing	ASNT	Perform tension pullout test on 10 percent of each post-installed anchor type and size.

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures ☐ Fabricator Exempt	PE/SE	- For pre-fabricated wood structural elements and assemblies, verify that the fabricator maintains detailed fabrication and quality control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to the Contract Documents and approved and accepted submittals. The special inspection shall review the procedures for completeness and adequacy relative to the requirements of codes and Laws and Regulations for the fabricator's scope of the Work. - If exempt, review fabricator's certification for fabrication by an approved special inspection agency and certificate of compliance stating that the Work was performed in accordance with the Contract Documents and approved or accepted submittals.
2. Diaphragms	PE/SE	- Review grade and thickness of wood structural panel sheathing to verify conformance with the Contract Documents. - Verify nominal size of framing members at adjoining panel edges, the nail or staple diameter and length, the number of fastener lines and that the spacing between fasteners in each line and at edge margins agrees with the Contract Documents.
3. Other:		

Mechanical & Electrical Systems

Item	Agency # (Qualif.)	Scope
1. Piping containing combustible or hazardous materials or piping where failure could damage the fire sprinkler system or other piping or equipment containing combustible or hazardous materials		• <i>Inspection of piping installation including vertical and lateral supports.</i> • <i>Inspection of post-installed concrete anchors for pipe, 3" and larger(continuous)</i>
2. Mechanical and process equipment containing combustible or hazardous materials		• <i>Review of manufacturer's certification that the equipment can resist the indicated seismic forces per the code without discharge of hazardous material.</i> • <i>Inspection of equipment installation and anchorage. (continuous for post-installed concrete anchors)</i>
3. Mechanical and electrical system components located where support failure could damage piping or equipment containing combustible and/or hazardous materials or the fire sprinkler system.		<i>Inspection of mechanical and electrical component installation including vertical and lateral supports.</i>
4. Tanks containing hazardous materials.		• <i>Review of manufacturer's certification that the tank and anchorage can resist the indicated seismic forces per the code without discharge of hazardous material.</i> • <i>Inspection of tank installation and anchorage. (continuous for post-installed concrete anchors)</i>

Architectural Systems

Item	Agency # (Qualif.)	Scope
1. Suspended Ceilings		<i>Inspection of suspended ceiling and associated lighting fixture installation including vertical and lateral supports.</i>
2.		
3.		
4.		

Special Cases

Item	Agency # (Qualif.)	Scope
1. Contractor statement of responsibility for structural seismic system construction		<i>Review statement of responsibility for:</i> <i>Awareness of requirements and control needed to meet seismic requirements.</i> <i>Procedures for exercising control and reporting on quality control</i> <i>Identification and qualifications of person(s) in contractor's organization responsible for quality assurance for seismic system construction.</i>
2. Contractor statement of responsibility for seismic system installation of piping containing combustible or hazardous materials or piping where failure could damage the fire sprinkler system or other piping or equipment containing combustible or hazardous materials		<i>Review statement of responsibility for:</i> <i>Awareness of requirements and control needed to meet seismic requirements.</i> <i>Procedures for exercising control and reporting on quality control</i> <i>Identification and qualifications of person(s) in contractor's organization responsible for quality assurance for seismic system construction.</i>
3. Contractor statement of responsibility for seismic system installation of mechanical and process equipment containing combustible or hazardous materials		<i>Review statement of responsibility for:</i> <i>Awareness of requirements and control needed to meet seismic requirements.</i> <i>Procedures for exercising control and reporting on quality control</i> <i>Identification and qualifications of person(s) in contractor's organization responsible for quality assurance for seismic system construction.</i>
4. Contractor statement of responsibility for seismic system installation of mechanical and electrical system components located where support failure could damage piping or equipment containing hazardous materials or the fire sprinkler system.		<i>Review statement of responsibility for:</i> <i>Awareness of requirements and control needed to meet seismic requirements.</i> <i>Procedures for exercising control and reporting on quality control</i> <i>Identification and qualifications of person(s) in contractor's organization responsible for quality assurance for seismic system construction.</i>
5. Contractor statement of responsibility for seismic system installation of tanks containing hazardous materials.		<i>Review statement of responsibility for:</i> <i>Awareness of requirements and control needed to meet seismic requirements.</i> <i>Procedures for exercising control and reporting on quality control</i> <i>Identification and qualifications of person(s) in contractor's organization responsible for quality assurance for seismic system construction.</i>

Supplement B - Final Report of Special Inspections

Project:

Location:

Owner:

Owner's Address:

Architect of Record:

Structural Engineer of Record:

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector

(Type or print name)

Signature

Date

Licensed Professional Seal

Agent’s Final Report

Project:

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Agent of the Special Inspector

(Type or print name)

Signature

Date

*Licensed Professional Seal or
Certification*

Supplement C - Contractor's Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated in the Quality Assurance Plan of Supplement A shall submit a Contractor's Statement of Responsibility.

Project:

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Contractor's Statement of Responsibility:

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Project's seismic requirements, Quality Assurance Plan in Supplement A, and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the Contract Documents approved by the Building Official having jurisdiction.

Signature

Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the Contractor's organization, the method and frequency of reporting and the distribution of reports are attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

Supplement D - Fabricator's Certificate of Compliance

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the International Building Code must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project:

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the Contract Documents.

Signature

Date

Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

SECTION 01500

TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide all temporary facilities necessary for the proper completion of the Work, as necessary and as specified.
- B. Maintain temporary facilities in proper and safe condition through the progress of the Work. In the event of loss or damage, immediately make all repairs and replacements necessary subject to approval of the Engineer and at no additional cost to City. At completion of the Work remove all such temporary facilities or as directed by the Engineer.

1.2 REQUIREMENTS

- A. General
 - 1. The materials, equipment, and furnishings provided under this Section shall be new, and shall meet all the applicable codes and regulations.
 - 2. Make all provisions, and pay all costs of furnishing, installation, maintenance, professional services, permit fees, and site work for the temporary facilities.
- B. Construction
 - 1. Temporary buildings shall be structurally sound, weather tight, with floors raised above ground. All mobile/modular buildings shall comply with GA-DCA/SBCC/ADA requirements, and shall be Williams-Scottsman or equal.
 - 2. Temporary buildings shall have temperature transmission resistance compatible with occupancy and storage requirements.

1.3 CONTRACTOR'S FACILITIES

- A. Contractor's Facilities: Submit a plan of the Contractor's facilities to Engineer for approval within 15 days of the Notice to Proceed. Contractor's facilities, for purposes of this Section, is defined to include but not limited to its field offices, first aid station, storage facilities, and laydown/staging areas. Sufficient construction facilities shall be provided and maintained at all points where work is in progress to meet adequately demands of the Work and with ample margin for emergencies or overload.

The facilities shall be of sufficient capacity and reliability to permit a rate of progress which will ensure completion of the Work within the time stipulated in the Contract.

The location of stationary and mobile equipment shall be subject to the City Engineer's approval.

- B. First Aid Stations: Contractor shall provide a suitable first aid station. Each station shall be equipped with all facilities and medical supplies necessary to administer emergency first aid treatment. Contractor shall have standing arrangements for the removal and hospital treatment of any injured person. The information reflecting this arrangement shall be clearly posted for easy visibility. All first aid facilities and emergency ambulance service shall be made available by Contractor to City's personnel and its representatives.

1.4 TELEPHONE SERVICES

General

- A. The Contractor shall provide all telephone services required for the proper completion of Contractor's work.
- B. All expenditures for installation costs of hardware, lines, line extensions, service changes, and recurring service charges for telephone service shall be paid by the Contractor.

1.5 PARKING FACILITIES

General

- A. Provide ample parking, either graveled or paved, adjacent to Project Office, without necessitating jockeying of cars, for a minimum of 5 cars at the Project Office. The parking surfaces shall be promptly and adequately maintained by the Contractor for the duration of the Contract.
- B. The parking facilities will be limited to the area(s) shown on the plans. The storage and work facilities provided by the City shall not be used for parking by the Contractor or its personnel. Additional parking facilities required by the Contractor shall be the Contractor's responsibility.

1.6 SECURITY AND MAINTENANCE

General

- A. Provide periodic indoor and outdoor maintenance and cleaning for temporary structures, furnishings, equipment and services as specified herein above.

- B. During other than normal daytime office working hours, provide a totally separate electronic security system monitored by a security agency for the Engineer's facilities. All offices shall be equipped with exterior security flood lights automatically activated by darkness and in sufficient number and placement to provide adequate lighting of the office and the parking areas.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

Fill and grade sites for temporary structures to provide surface drainage

3.2 INSTALLATION

- A. Construct temporary field offices, first aid stations, and storage facilities on proper foundations and provide connections for utility all services.
- B. Locate construction office facilities at locations within the Project approved by the City Engineer.
- C. Determine the need for temporary utility services, including utility services for the Project Office and first aid stations, and make all arrangements with utility companies and governmental agencies to secure such services. Such services shall be provided at no additional cost to the City. Temporary utility services shall be furnished, installed, connected, and maintained by Contractor in a workmanlike manner, satisfactory to the Engineer, and shall be removed in like manner prior to final acceptance.
- D. Provide an outside standpipe equipped with a non-freeze hose bib at the Project Office. The hose bib is to be sized for a standard ½" garden hose connection.

3.3 MAINTENANCE AND CLEANING

Repair and clean the offices, parking areas and access routes and provide complete professional janitorial services, including toilet paper and paper towels, in the Project Office for the duration of the project. Cleaning shall be done on a daily basis, to the satisfaction of the City Engineer, during other than normal daytime office working hours. These services shall include sweeping, vacuuming, dusting, emptying of trash, cleaning of wash basins, bathroom and shower facilities, daily mopping and monthly waxing of all vinyl floors. Contractor shall also provide for monthly exterminating services of the offices.

3.4 REMOVAL

- A. Remove temporary field offices, contents and services at a time when no longer needed. The office contents shall be packed, moved, and unpacked by the Contractor to a location designated by the City.
- B. Remove foundations and debris; grade site to required elevations; clean and restore areas to City Engineer's satisfaction.

+++ END OF SECTION 01500 +++

SECTION 01520

SAFETY

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall be responsible for conducting all Work in a safe manner and shall take reasonable precautions to ensure the safety and protection of workers, property and the general public.
- B. The Contractor shall comply fully with all applicable safety standards while conducting work on this project. These standards include all Federal and Local Occupational Safety and Health standards for General Industry (29 CFR Part 1910) and applicable standards in 29CFR Part 1926 for the Construction Industry.
- C. The Contractor shall designate a trained and qualified employee who is to be responsible for ensuring that the Work is performed safely and in conformance with all applicable regulations.
- D. The Contractor shall determine the safety hazards involved in completing the Work and the precautions necessary to conduct the Work safely.
- E. The Contractor shall bear all risks associated with performing the Work and shall fully indemnify and hold harmless the City and Engineer.
- F. Contractor shall use safety barriers such as safety cones or yellow caution tape where needed to indicate areas where work is in progress.

1.2 SUBMITTALS

- A. The Contractor shall submit a copy of their current safety program.
- B. OSHA 300 logs for previous 3 years prior to bid.
- C. Confined space entry training records of employees before they are allowed to work in confined spaces.
- D. All Confined Space Entry Permits completed during the project.

1.3 DEFINITIONS

- A. Contract Personnel: Includes employees of the Contractor and any Subcontractors or other firms working on this Contract.
- B. LEL: Lower Explosive Limit

- C. Manager: The Facility Manager or his designee
- D. OSHA: Occupational Safety and Health Administration
- E. Work: Inclusive of all activities required to complete this task.

1.4 SPECIAL REQUIREMENTS

- A. The Contractor's attention is directed to the fact that construction activities involving sanitary sewer systems will occasionally involve work in potentially hazardous environments in which oxygen deficient, toxic or explosive conditions may exist. Additional hazards arise from the presence of pathogens in the wastewater, from the slime and scum (coating walking, working and other surfaces), and naturally occurring animal and insect hazards such as snakes and mosquitoes. In dealing with these hazards, the Contractor shall take special precautions to ensure worker safety. Such precautions shall include, but are not limited to the following as applicable:
 - 1. Installing temporary forced air ventilation equipment and ducts for fresh air in enclosed areas.
 - 2. Using pneumatic tools and equipment instead of electric-driven equipment in hazardous areas.
 - 3. Avoid the use of cutting torches, field welding and grinders in hazardous areas.
 - 4. Cleaning and disinfecting working surfaces with hot water, high pressure washers prior to commencing work.
 - 5. Providing portable oxygen meters, combustible gas detectors and hydrogen sulfide detectors to continuously monitor the atmosphere in enclosed working areas or when hot work is being performed.
 - 6. Providing safety harnesses, safety lines and recovery crews for workers in hazardous areas.
 - 7. All Exposed moving parts on equipment used shall be provided with guards which meet the requirements of OSHA. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION AUTOMATIC EQUIPMENT MAY START AT ANY TIME".
 - 8. Providing dry chemical fire extinguishers and connected fire hoses in areas where a danger of fire or explosion exists.
 - 9. Providing suitable wash-up areas and facilities for workers.
 - 10. Installing temporary lighting using explosion-proof fixtures in hazardous environments.
 - 11. Installing approved warning and hazard signs and posting safety procedures.
 - 12. Instructing all workers as to the hazards present, the procedures to be followed and the proper function and use of all safety and emergency equipment furnished.

- B. Prior to commencing Work on existing facilities and equipment, the Contractor shall notify the Manager and shall ensure that the source of electrical energy to all affected equipment is shutoff and locked out at the appropriate motor control center. Local switches and pushbutton stations, where provided, shall be locked in the “off” position.
- C. Throughout the duration of the project, the Confined Space Entry Permit (Form 01520-A) must be completed each day and posted at the jobsite. Atmospheric monitoring of the confined spaces must be done prior to entry and whenever any employee enters a confined space. All expired permits must be maintained during the project and submitted to the City with any pay request.
- D. For areas where safety handrails or channel grating are removed for repair, workers shall wear safety harnesses with a safety line. The area shall also be marked off with yellow caution tape and safety cones while work is in progress.
- E. Contractor employees shall wear at a minimum safety glasses and steel toe shoes at all times while working at the facility. The Contractor’s safety program may require additional personal protective equipment be worn.
- F. Contractor shall verify that the conditions are safe before entering and beginning the Work. Provide additional safety improvements as needed to make the work space safe.
- G. Contractor shall have personnel trained as entrants, attendants and rescue personnel following OSHA Confined Space Entry guidelines. Documentation of each employee’s training records shall be submitted to the City prior to any entry of personnel into confined spaces. Personnel not having the appropriate training to enter confined spaces are not allowed to work in confined spaces. In addition, work in confined spaces will not be allowed without an attendant and standby rescue personnel available.
- H. The Contractor shall maintain continuous atmospheric monitoring while personnel are inside confined spaces for oxygen levels, percent LEL, carbon monoxide, and hydrogen sulfide. Monitoring devices shall be equipped with alarms to automatically warn workers of the onset of dangerous atmospheric conditions. The Contractor shall have immediately available confined space rescue equipment and personnel certified in its use during times when personnel are working in confined spaces.

+++ END OF SECTION 01520 +++

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FORM 01520-A
CONFINED SPACE ENTRY PERMIT

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CONFINED SPACE ENTRY PERMIT	
(THIS PERMIT MUST BE POSTED AT JOB SITE) Tracking Number: _____	
Confined Space to be Entered: _____	Work Order # _____ Date _____
Location: _____	Permit Expiration Date/Entry Time: _____
Description of Work to be Performed: _____ _____	
NATURE OF HAZARDS IN CONFINED SPACE: (CHECK) ☐ Oxygen deficiency (Less than 19.5% at sea level) ☐ Flammable gases or vapors (greater than 10% of the lower flammable limit, or greater than 23.5% oxygen at sea level) ☐ Toxic gases or vapors (greater than the permissible exposure limit) ☐ Mechanical hazards ☐ Electrical shock ☐ Materials harmful to the skin ☐ Engulfment ☐ Other _____	EQUIPMENT REQUIRED FOR ENTRY AND WORK: (CHECK) ☐ Respirator: Airline, Air Supplied w/Egress, SCBA, Air Purifying, Cartridge type, Disposal Brand ☐ Fall Protection Equipment: Full Body Harness w/"D" Ring and lifeline ☐ Protective Clothing: Safety glasses, chemical goggles, face shield, safety glasses, hard hat, safety shoes, rubber boots, gloves ☐ Protective clothing: Cotton Coveralls, Tyvek suit, coated Tyvek suit, other ☐ Hearing protection ☐ Other _____ Respiratory Protection (specify) _____ Communication aid (specify) _____ Rescue equipment (specify) _____ Electrical equipment/tools: ☐ Low voltage ☐ Ground-fault current interrupters ☐ Approved for hazardous location ☐ All electrical equipment listed Class 1, Division 1, Group D and non-sparking tools
PREPARATION: (check) ☐ Notify affected department of service interruption ☐ Isolate – blanked or double valve, with lock and tag ☐ Zero energy state (Lock Out all energy sources) ☐ Cleaned, drained, washed and purged ☐ Grounding and bonding wire in place ☐ Ventilation equipment to provide fresh air in use ☐ Procedures reviewed with each employee ☐ Atmospheric test in compliance ☐ Employees informed of specific confined space hazards ☐ Attach hot work permit ☐ Emergency response team available ☐ Other _____	AUTHORIZED ENTRANTS: _____ _____ _____ AUTHORIZED ATTENDANTS: _____ _____ _____
Entry Supervisor _____	

Confined Space Permit
Revised May 31, 2000

Test	Allowable Limits	Check (✓) If required	Result	Result	Result	Result	Result	Result
Time								
Oxygen-min.	19.5%							
Oxygen-max.	23.5%							
Flammability	10% LEL							
H ₂ S	10 ppm							
Toxic (specify)								
Cl ₂	.5 ppm							
ClO ₂	.1 ppm							
SO ₂	.2 ppm							
Heat	°F/°C							
Other								
Other								

Name of employee conducting atmospheric monitoring: _____

Instrumentation (Serial #/Calibration Date): _____

RETEST AFTER VENTILATION, BUT PRIOR TO ENTRY (PERIODICALLY AS APPROPRIATE)

IF HAZARD IS DETECTED: LEAVE THE CONFINED SPACE. REEVALUATE THE SITE. CORRECT ANY PROBLEMS.

Authorization:

I certify that all required precautions have been taken and necessary Equipment is provided for safe entry and work in this confined space.

Name (Print): _____

Time: _____

Date: _____

Signature _____

Confined Space Permit
Revised May 31, 2000

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

SECTION 01540

SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SECURITY PROGRAM

- A. The Contractor shall protect the Work, including all field office trailers and their contents from theft, vandalism, and unauthorized entry.
- B. The Contractor shall initiate a site security program at the time of mobilization onto the worksite, which provides adequate security for site stored and installed material.
- C. The Contractor shall maintain the security program throughout the Contract duration.
- D. The Contractor and subcontractors are wholly responsible for the security of their storage compound and lay down areas and for all their plant, material, equipment and tools at all times.
- E. The Contractor shall provide the City Engineer with a list of 24 hour emergency phone numbers including chain of command.

1.2 ENTRY CONTROL

- A. The Contractor shall restrict entry of unauthorized personnel and vehicles onto the Project site.
- B. The Contractor shall allow entry only to authorized persons with proper identification.
- C. The Contractor shall maintain an Employee Log and Visitor Log and make the log available to the City upon request. This log shall be submitted to the City Engineer bi-weekly or as necessary.
- D. The Contractor shall require all visitors to sign the Visitor Acknowledgment of the Program Site Rules/Visitor Log, which includes a release form. Copies of these forms shall be submitted to the Engineer bi-weekly and maintained in the Contractor's security files on-site.
- E. The Contractor shall require all employees to sign the Employee Acknowledgment of Project Site Rules Log included at the end of this Section. All employees, subcontractor employees and lower tier contractor employees will receive a new employee orientation. Signing the Employee Log by the employee is certifying that the orientation training has been received.

- F. The City Engineer has the right to refuse access to the site or request that a person or vehicle be removed from the site if found violating any of the Project safety, security conduct rules.

1.3 BARRICADES, LIGHTS AND SIGNALS

- A. The Contractor shall furnish and erect such barricades, fences, lights and danger signals and shall provide such other precautionary measures for the protection of persons or property and of the work as necessary. Barricades shall be painted in a color that will be visible at night. From sunset to sunrise, the Contractor shall furnish and maintain at least one light at each barricade and sufficient numbers of barricades shall be erected to keep vehicles from being driven on or into any work under construction.
- B. The Contractor will be held responsible for all damage to the work and any resulting injuries due to failure of barricades, signs and lights and whenever evidence is found of such damage, the Contractor shall immediately remove the damaged portion and replace it at Contractor's cost and expense. The Contractor's responsibility for the maintenance of barricades, signs and lights shall not cease until the Project has been accepted by the City.

1.4 RESTRICTIONS

The Contractor shall not allow cameras on site or photographs taken except with approval of the City or the Engineer.

1.5 CONTRACTOR SAFETY/HEALTH AND SECURITY PLAN

- A. Prior to the performance of any work the Contractor will prepare a contract specific Safety/Health and Security Plan signed by an officer of the Contractor's organization. Adequacy is the responsibility of the Contractor. The plan shall include site specific elements for each work site.
- B. The Contractor's safety plan will not be reviewed for the adequacy of the plan. The plan shall:
 - 1. Identify the person(s) responsible for implementation and enforcement of Safety/Health and Security rules and regulations for this Project.
 - 2. Generally address safe work procedures for the activities within the Contractor's scope of work.
 - 3. Include a new employee orientation program, which addresses job and site specific rules, regulations and hazards.
 - 4. Include the Contractor's Drug Free Work Place Policy including substance abuse prevention and testing program.

5. Include provisions to protect all of the Contractor's employees, other persons and organizations who may be affected by the work from injury, damage or loss.
 6. Comply with current Fed/OSHA, Safety/Health and Security Plan, facility safety program (when applicable), and locally accepted safety codes, regulations and practices.
 7. Include a site specific emergency action and evacuation plan.
 8. Include Hazard Communication/Right To Know Program.
 9. Include security procedures for the Contractor's work, tools, and equipment.
 10. Include the capability of providing the City Engineer with documentation to show compliance with their plan, plus accidents and investigation reports.
 11. Address any other contract specific requirement, including the, Unique Requirements of these specifications.
- C. Provide a Job Safety Analysis (JSA) for the scope of work, prior to the start of work.
- D. Review of the Contractor's Safety Plan by the City Engineer shall not impose any duty or responsibility upon the City Engineer for the Contractor's performance of the work in a safe manner.
- E. The Contractor shall be fully responsible for the safety and health of its employees, its subcontractors and lower tier contractors during performance of its work.
- F. The Contractor shall provide the City Engineer with all safety reports, training records, competent person list, and accident reports prepared in compliance with Fed/OSHA and the Project Safety/Health and Security Plan.

1.6 PROJECT SAFETY COORDINATOR

- A. The Contractor shall be responsible for the safety of the Contractor's and Engineer's employees, the City's personnel and all other personnel at the site of the Work. The Contractor shall identify a Project Safety Coordinator, as required under GC-18, Paragraph F., on the job with an appropriate office on the job site to maintain and keep available safety records and up-to-date copies of all pertinent safety rules and regulations.
- B. The Project Safety Coordinator shall:
1. Ensure compliance with all applicable health and safety requirements of all governing legislation.
 2. Schedule and conduct safety meetings and safety training programs as required by law for all personnel engaged in the work.

3. Post all appropriate notices regarding safety and health regulations at locations that afford maximum exposure to all personnel at the job site.
4. Post the name, addresses, and hours of the nearest medical doctor; names and addresses of nearby clinics and hospitals; and the telephone numbers of the fire and police departments.
5. Post appropriate instructions and warning signs with regard to all hazardous areas or conditions.
6. Have proper safety and rescue equipment adequately maintained and readily available for any contingency. This equipment shall include such applicable items as: proper fire extinguishers, first aid kits, safety ropes and harnesses, stretcher, life savers, oxygen breathing apparatus, resuscitators, gas detectors, oxygen deficiency indicators, explosion meters, and any other equipment mandated by law.
7. Make inspections at least once daily in accordance with an inspection checklist report form to ensure that all machines, tools and equipment are in safe operating condition; that all work methods are not dangerous; and that all work methods are free of hazards.
8. Submit to the City Engineer upon request copies of all inspection checklist report forms, safety records and all safety inspection reports and certifications from regulating agencies and insurance companies.
9. Notify City Engineer of a serious accident immediately, followed by a detailed written report within twenty-four (24) hours. "Serious accident" is defined as that requiring an absence of work of more than 2 days and/or hospitalization.
10. Notify the City Engineer immediately in the event of a fatal accident.
11. Notify Engineer of any accident claim against the Contractor or any sub-contractor immediately, followed up by a detailed written report on the claim and its resolution.
12. Review safety aspects of the Contractor's submittals as applicable.

1.7 ACKNOWLEDGMENT OF THE PROJECT SITE RULES

The acknowledgements below shall be included as part of the visitor and employee sign-in logs. No access to the site shall be permitted without acknowledgement of the Project Site Rules.

VISITOR ACKNOWLEDGEMENT OF THE PROJECT SITE RULES

By signing this Visitor's Log, I acknowledge that I understand and agree to abide by the project rules outlined below.

In consideration of my receipt of a visitor's pass as issued by the Engineer directly or indirectly for the City of Atlanta, I waive on behalf of myself, my heirs, employer, legal representatives and assigns and hereby release and discharge the City, Engineer, Designer, and their subcontractors and consultants and each of their directors, officers, employees, representatives and agents from any and all claims, actions, causes of action or any charge of any kind whatsoever which may arise or could arise in the future as a result of my being present at the facility including injury, death or property damage whether or not caused by the fault or negligence of any of the parties released hereunder.

I further acknowledge that I have been briefed on specific hazards, hazardous substances that are on site and the site emergency action procedure.

PROHIBITED ACTIVITIES

- Unauthorized removal or theft of CITY's property
- Violation of safety or security rules or procedures
- Possession of firearms or lethal weapons on jobsite
- Acts of sabotage
- Destruction or defacing CITY's property
- Failure to use sanitary facilities
- Failure to report accidents or job related injuries
- Being under the apparent influence of drugs, alcohol or other intoxicants or in possession of drugs, alcohol or other intoxicants on the property
- Wearing shorts or tennis shoes on the jobsite
- Failure to wear a hardhat/safety glasses.
- Gambling at any time on the project
- Fighting, threatening behavior, or engaging in horseplay on the project
- Smoking in unauthorized areas on the project
- Open fire cooking or making unauthorized fires on project property
- Selling items or raffles without authorization
- Use of unauthorized cameras on the project
- Use of radio or television in the construction area
- Failure to park personal vehicle in authorized parking area
- Failure to wear designated identification [Site Specific]
- Failure to use designated gates

I have read, understand and agree to abide by the PROJECT SITE RULES. Furthermore, I understand failure to abide by these rules is grounds for being denied access to the project site. I have received a personal copy for my use and reference.

VISITOR LOG

THE SIGNING OF THIS LOG ACKNOWLEDGES I HAVE READ AND UNDERSTAND AND AGREE TO ABIDE BE THE PROJECT RULES OUTLINE ABOVE. THIS IS NOT A VEHICLE ACCESS PERMIT.

VISITOR'S NAME PRINT	SIGNATURE	COMPANY VISITED	DATE	IN	OUT

EMPLOYEE ACKNOWLEDGMENT OF THE PROJECT SITE RULES

By Signing this Employee Log, I acknowledge that I understand and agree to abide by the project rules outlined below.

PROHIBITED ACTIVITIES

- Unauthorized removal or theft of CITY's property
- Violation of safety or security rules or procedures
- Possession of firearms or lethal weapons on jobsite
- Acts of sabotage
- Destruction or defacing CITY's property
- Failure to use sanitary facilities
- Failure to report accidents or job related injuries
- Under the apparent influence of drugs, alcohol or other intoxicants or in possession of drugs, alcohol or other intoxicants on the property
- Wearing shorts or tennis shoes on the jobsite
- Failure to wear a hardhat
- Gambling at any time on the project
- Fighting, threatening behavior, or engaging in horseplay on the project
- Smoking in unauthorized areas on the project
- Open fire cooking or making unauthorized fires on project property
- Selling items or raffles without authorization
- Use of unauthorized cameras on the project
- Use of radio or television in the construction area
- Failure to park personal vehicle in authorized parking area
- Failure to wear designated identification [Site Specific]
- Failure to use designated gates

I have read, understand and agree to abide by the PROJECT SITE RULES. Furthermore, I understand failure to abide by these rules is grounds for being denied access to the project site. I have received a personal copy for my use and reference.

EMPLOYEE LOG

BY SIGNING THIS LOG ACKNOWLEDGMENT I HAVE READ AND UNDERSTAND AND AGREE TO ABIDE BY THE PROJECT RULES OUTLINED ABOVE AND ALL STATE, FEDERAL, LOCAL OR ANY OTHER CONTRACT OBLIGATIONS THAT MAY APPLY. I FURTHER ACKNOWLEDGE THAT I HAVE BEEN ORIENTATED AS TO THE SITE SPECIFIC HAZARDS, ANY HAZARDOUS SUBSTANCES I MAY BE EXPOSED TO WHILE ON THE SITE AND THE SITE/COMPANY EMERGENCY ACTION PROCEDURES, BY A REPRESENTATIVE OF THE COMPANY.

EMPLOYEES (PRINT)	SIGNATURE	COMPANY NAME	DATE

+++ END OF SECTION 01540 +++

SECTION 01550

TRAFFIC REGULATIONS

PART 1 - GENERAL

1.1 SCOPE

The work specified in this section includes the provision of products, permits, services, procedures and personnel by the Contractor to effect traffic control during the Work.

1.2 TRAFFIC CONTROL MANAGER REQUIREMENTS

- A. The Contractor shall designate a qualified individual as the Traffic Control Manager (TCM) who shall be responsible for selecting, installing and maintaining all traffic control devices in accordance with the Plans and Specifications and the Manual of Uniform Traffic Control Devices (MUTCD). A written resume documenting the experience and credentials of the TCM shall be submitted and accepted by the Engineer prior to beginning any work that involves traffic control. The TCM shall be available on a twenty-four (24) hour basis to perform his duties. If the work requires traffic control activities to be performed during the daylight and nighttime hours it may be necessary for the Contractor to designate an alternate TCM. An alternate TCM must meet the same requirements and qualifications as the primary TCM and be accepted by the Engineer prior to beginning any traffic control duties. The Traffic Control Manager's traffic control responsibilities shall have priority over all other assigned duties.
- B. As the representative of the Contractor, the TCM shall have full authority to act on behalf of the Contractor in administering the Traffic Control Plan. The TCM shall have appropriate training in safe traffic control practices in accordance with Part VI of the MUTCD. In addition to the TCM all other individuals making decisions regarding traffic control shall meet the training requirements of Part VI of the MUTCD. The TCMs shall supervise the initial installation of traffic control devices. The Engineer prior to the beginning of construction will review the initial installation. Modifications to traffic control devices as required by sequence of operations or staged construction shall be reviewed by the TCMs.

PART 2 - PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

- A. The Contractor shall provide post-mounted and wall-mounted traffic control and informational signs as specified and required by local jurisdictions.
- B. The Contractor shall provide automatic traffic control signals as approved by local jurisdictions.
- C. The Contractor shall provide traffic cones and drums, and flashing lights as approved by local jurisdictions.
- D. The Contractor shall provide flagmen equipment as required by local jurisdictions.

PART 3 - EXECUTION

3.1 PERMITS

- A. The Contractor shall obtain permits from authorities having jurisdiction over road closures before closing any road. The Contractor shall use forms provided by authorities having jurisdiction (City of Atlanta Division of Traffic and Transportation, GDOT, etc).
- B. The Contractor shall either fax or hand carry permit applications to the City of Atlanta Division of Traffic and Transportation. Permit applications shall indicate the time (in days); length (in feet); the number of lanes; and the purpose of the closure.
- C. Full street closures permits require ninety-six (96) hours advance notice prior to road closure. The following additional information is required prior to approval:
 - 1. The recommended detour route with signage and Traffic Management Plan as per the Manual of Uniform Traffic Control Devices (MUTCD).
 - 2. A copy of the resident and/or business notification letters about the closure. The residents/businesses located between the detour route must be notified about the closure at least five (5) business days prior to the proposed closure.
- D. The City of Atlanta Division of Traffic and Transportation will return full road closure permit applications to the Contractor with a cover letter to the Fire Chief, Chief of Police, Grady Memorial Hospital, MARTA, and the Atlanta Board of Education. The Contractor shall have received the

permit application and cover letter at least seventy-two (72) hours before commencing road closure activities.

- E. Lane closures shall require a minimum of forty-eight (48) hour notice prior to closure. The Contractor shall continuously maintain the safety of the traveling public during lane closures in accordance with the requirements of the MUTCD and as stipulated by public officers. Lane closure permits are issued between 8:30 a.m. and 1:00 p.m. Mondays through Fridays.
- F. The City of Atlanta Division of Traffic and Transportation will return the lane closure applications to the Contractor with a cover letter with copies to the Fire Chief, Chief of Police, Grady Memorial Hospital, MARTA, and the Atlanta Board of Education. The Contractor shall have received the permit application and cover letter at least seventy-two (72) hours before commencing lane closure activities.

3.2 PREPARATION OF TRAFFIC CONTROL PLANS

In accordance with the specifications, permitting agencies, and the MUTCD, the Contractor shall develop detailed staging and traffic control plans for performing specific areas of the Work including but not limited to all requirements for certified flagmen, additional traffic control devices, traffic shifts, detours, paces, lane closures or other activities that disrupt traffic flow. The Contractor shall submit these plans in accordance with the Specifications to receive final approvals from permitting agencies and provide any and all required traffic control devices as required by both the permitting agencies and these specifications at no additional cost to the City.

3.3 CONSTRUCTION PARKING CONTROL

- A. The Contractor shall control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and City's operations.
- B. The Contractor shall monitor parking of construction personnel's vehicles in existing facilities and maintain vehicular access to and through parking areas.
- C. The Contractor shall prevent parking on or adjacent to access roads or in nondesignated areas.

3.4 MAINTENANCE OF TRAFFIC

- A. Whenever and wherever, in the City Engineer's opinion, traffic is sufficiently congested or public safety is endangered, the Contractor shall furnish uniformed officers to direct traffic and to keep traffic off the highway area affected by construction operations.

- B. When the Contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of Work that is otherwise provided for in the Plans and these Specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to safely accommodate traffic. The Contractor shall furnish, erect and maintain barricades, warning signs, flagmen, and other traffic control devices in conformity with the requirements of the Georgia Department of Transportation and other Local Jurisdictions. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary to ingress to and egress from abutting property or intersecting roads, streets, or highways. The Contractor shall maintain traffic in accordance with any traffic control plans furnished with and made a part of the Plan assembly.
- C. The Contractor shall make his own estimate of all labor, materials, equipment, and incidentals necessary for providing the maintenance of traffic as specified in this section.
- D. Unless specified in the Plans or these Specifications and subject to the approval of the City, the cost of maintaining traffic specified in this section shall be considered incidental to the Work and no separate measurement or payment will be made.

3.5 UNIFORMED POLICE OFFICER FOR TRAFFIC CONTROL

- A. The Contractor shall provide uniformed police officers to regulate traffic when construction operations encroach on public traffic lanes, as approved by the City Engineer.
- B. Officers will be currently employed by a local jurisdiction, be in full uniform and have full arrest power while working.
- C. Officers will be employed and paid by the Contractor.
- D. It is the Officers' responsibility to assist in the direction of traffic within the construction site.

3.6 FLAGMEN

The Contractor shall provide trained and equipped flagmen to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.7 FLASHING LIGHTS

The Contractor shall use flashing lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.8 HAUL ROUTES

- A. The Contractor shall consult with authorities and establish public thoroughfares to be used for haul routes and site access.
- B. The Contractor shall confine construction traffic to designated haul routes.
- C. The Contractor shall provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.9 ROAD CLOSURES ON CITY ROADS

- A. No street, road, or highway shall be closed without the permission of the owner of any street, road, or highway and the fire department having jurisdiction. Prior to closing a street, road, or highway, signs shall be posted for a minimum of seven (7) days prior to actual closing, forewarning of the imminent closing. The City shall determine the information to be placed upon the signs by the Contractor. Where traffic is diverted from the Work, the Contractor shall provide all materials and perform all work for the construction and maintenance of all required temporary roadways, structures, barricades, signs, and signalization.
- B. To obtain approval to close a road or street maintained by the City, the Contractor must proceed as follows:
 - 1. The Contractor must obtain approval of his traffic plan from the City Engineer. The traffic plan must be in accordance with the requirements of the Georgia Department of Transportation and the City of Atlanta.
 - 2. The Contractor must obtain a utility permit.
 - 3. The Contractor must apply in writing to the City and obtain a permit to close the road on a specific date. Routine permit approval by the City requires from one (1) to two (2) weeks depending on when the application is received.
 - 4. The Contractor must obtain a permit from the City before posting closure signs. Signs must be posted for seven (7) days prior to the first day of closure. Signs must be acceptable to the Engineer.
 - 5. Emergency road closures will be handled by the City Engineer.

3.10 PROCEDURES FOR TRAFFIC DETOUR ROUTE PLAN

- A. The Contractor shall provide a sketch map showing his traffic detour route plan to the City Engineer. The sketch map need not be drawn to scale but should resemble, as closely as possible, the actual location. The sketch map shall be drawn in a manner so as to provide emergency agencies a better understanding of the detour for quick response. The sketch map shall include directional arrows showing the flow of traffic.

- B. “Road Closed Ahead” signs shall be erected before the start point of the detour indicating the name of the street closed.
- C. Detour signs with appropriate directional arrows shall be erected at every intersection along the detour route until the end of the detour, when the traffic is back to the original street.
- D. The Contractor shall erect an “End Detour” sign at the end of the detour.
- E. Each detour and “End Detour” sign shall be accompanied by an accessory plate indicating the name of the street being detoured.
- F. The Contractor shall apply appropriate traffic control measures in accordance with the requirements of the MUTCD and the City of Atlanta codes.

3.11 BARRICADES AND WARNING SIGNS

- A. The Contractor shall furnish, erect, and maintain all barricades and warning signs for hazards necessary to protect the public and the Work. When used during periods of darkness, such barricades, warning signs and hazard markings shall be suitably illuminated or reflectorized.
- B. For vehicular and pedestrian traffic, the Contractor shall furnish, erect, and maintain barricades, warning signs, lights, and other traffic control devices in conformity with the requirements of the Georgia Department of Transportation and the City of Atlanta.
- C. The Contractor shall furnish and erect all barricades and warning signs for hazards prior to commencing Work which requires such erection and shall maintain the barricades and warning signs for hazards until their dismantling is directed by the Engineer.

3.12 REMOVAL

The Contractor shall remove equipment and devices when no longer required and repair damage caused by installation.

+++ END OF SECTION +++



City of Atlanta

**Department of Public Works
Office of Transportation**

City's Public Right-of-Way Manual

*Department of Public Works
Office of Transportation
Transportation Engineering*

Appendix A:

Arterial Streets

Alphabetical Listing

Note: Streets listed may also be classified as State or Federal Highways and may be identified by a highway number designation.

<u>STREET NAME</u>	<u>SEGMENT</u>	<u>Miles</u>
Baker Street, N.E.	Luckie Street to Piedmont Avenue	0.76
Bankhead Highway, N.W.	Marietta Street to City Limits	6.4
Bell Street, N.E.	Auburn Avenue to Hill Street	0.38
Bolton Road, N.W.	Fulton Industrial Blvd. to Marietta Blvd	3.0
Briarcliff Road, N.E.	Ponce de Leon to City Limits	0.47
Buford Highway, N.E.	City Limits to Piedmont Road	1.1
Campbellton Road, S.W.	Lee Street to 166	4.53
Campbellton Road, S.W.	166 to City Limits	2.65
Candler Road, N.E. & S.E.	City Limits to City Limits	0.70
Capitol Avenue, S.W.	University Avenue to MLK Jr. Drive	1.8
Cascade Road, S.W.	City Limits to Gordon Street	3.06
Central Avenue, S.W.	Dodd Avenue to Edgewood Avenue	1.4
Cheshire Bridge Road, N.E.	Piedmont Road to Buford Highway	1.4
Cleveland Avenue, S.E. & S.W.	City Limits to Jonesboro Road	2.85
Courtland Street, N.E.	North Avenue to MLK Jr., Drive	1.5
Crown Road, S.W.	City Limits to City Limits	0.55
Decatur Street, S.E.	Peachtree Street to Gunby Street	1.4
Dekalb Avenue, N.E.	City Limits to Gumby Street	3.1
East Roxboro Road, N.E.	West Roxboro Road to Wood Circle	0.2
Edgewood Avenue, N.E.	Peachtree Street to Krog Street	1.5
Fulton Industrial Blvd., S.W.	Old Gordon Road to Bolton Road	1.8
Fulton Street, S.W.	Pryor Street to Capitol Avenue	0.4
Georgia Avenue, S.W.	Glenn Street to Capitol Avenue	1.15
Glenn Street, S.E.	Murphy Avenue to Stewart Avenue	0.2
Glenwood Avenue, S.E.	Hooper Street to Clifton Street	2.35
Gordon Street, S.W.	Cascade Avenue to Glenn Street	1.2
Harris Street, N.E.	Luckie Street to Piedmont Avenue	0.7
Hightower Road, N.W.	Bankhead Highway to MLK Jr., Drive	1.7
Hill Street, S.E.	Bell Street to Glenwood Avenue	0.4
Howell Mill Road, N.E.	Collier Road to Marietta Street	2.1
International Blvd., N.E.	Northside Drive to Piedmont Avenue	1.2
James Jackson Parkway, N.W.	City Limits to Bankhead Highway	3.0
Jonesboro Road, S.E.	City Limits to McDonough Blvd.	5.4
Juniper Street, N.E.	14 th Street to North Avenue	1.0
Lakewood Avenue, S.E.	166 to Jonesboro Road	1.1
Lavista Road, N.E.	Cheshire Bridge Road to City Limits	0.18
Lee Street, S.W.	City Limits to West Whitehall St.	2.4
Linbergh Drive, N.E.	Peachtree Road to Cheshire Bridge Road	2.1
Macon Drive, S.E.	Cleveland Avenue to Lakewood Avenue	1.35
Memorial Drive, S.W. & S.E.	Peachtree Street to City Limits	6.0
Marietta Blvd., N.W.	City Limits to West Marietta Street	3.3

Marietta Street, N.W.
 MLK Jr. Drive, S.E. & N.W.
 Mitchell Street, S.W.
 Moreland Avenue, S.E. & N.E.
 McDonough Blvd., S.E.
 North Avenue, N.W. & N.E.
 Northside Drive, N.W.
 Northside Parkway, N.W.
 Old Gordon Road, S.W.
 Peachtree St. & Rd., N.W. & N.E.
 Peachtree Center Avenue, N.E.
 Peachtree Dunwoody Rd., N.E.
 Peters Street, S.W.
 Piedmont Avenue, S.E. & N.E.
 Piedmont Road, N.E.
 Ponce De Leon, N.E.
 Pryor Street, S.W.
 Ridge Avenue, S.E.
 Roswell Road, N.E. & N.W.
 Roxboro Road, N.E.
 Sawtell Avenue, S.E.
 South West Connector, S.W.
 Spring Street, S.W. & N.W.
 Stanton Road, S.W.
 Steward Avenue, S.W.
 Techwood Drive, N.W.
 Trinity Avenue, S.W.
 Walker Street, S.W.
 Washington Street, S.W.
 West Marietta Street, N.W.
 West Peachtree Street, N.W.
 West Whitehall Street, S.W.
 Whitehall Street, S.W.
 Williams Street, N.E.

Total # of Arterial Streets = 75

Peachtree Street to West Marietta Street	2.5
Hill Street to City Limits	8.7
Martin Luther King Jr. Dr. to Capitol Avenue	0.9
Ponce de Leon Avenue to City Limits	5.7
Moreland Avenue to University Avenue	2.5
Northside Drive to Bonaventure Avenue	2.5
Steward Avenue to Northside Parkway	7.1
Northside Drive to City Limits	3.6
MLK Jr. Dr. to Fulton Industrial Blvd	0.38
Memorial Drive to City Limits	10.0
Decatur Street to Edgewood Avenue	0.1
Roxboro Road to Meadowbrook Drive	1.9
Trinity Street to West Whitehall Street	1.0
ML King Jr. Dr. to Cheshire Bridge Road	4.3
Cheshire Bridge Road to Roswell Road	3.5
Peachtree Street to City Limits	3.2
Edgewood Avenue to University Avenue	2.3
Capitol Avenue to Pryor Street	0.4
Peachtree Road to City Limits	2.7
Peachtree Road to East Roxboro Road	0.9
McDonough Blvd. to Jonesboro Road	0.7
West Marietta Street to Bankhead Highway	1.0
Peachtree Street to Trinity Avenue	2.25
Campbellton Road to City Limits	0.4
City Limits to Glenn Street	4.5
West Peachtree Place to Walker Street	0.95
Spring Street to Memorial Drive	0.5
Techwood Drive to Peters Street	0.4
Martin Luther King Jr. Dr. to Memorial Drive	0.21
Ashby Street to Marietta Blvd.	0.55
Peachtree Street to Peachtree Street	2.2
Lee Street to Peters Street	1.52
Memorial Drive to Murphy Avenue	0.8
West Peachtree Place to International Blvd.	0.3

Total # of Miles 158.24

Appendix B: State Routes

STATE ROUTE	FROM	TO
S. R. 3; U.S. 19/41 (Metropolitan Parkway)	A point 50 feet north of Mt. Zion Road (Hapeville city limits)	Northside Drive
S. R. 3 ; U.S. 19/29/41 (Northside Drive)	Metropolitan Parkway	A point 0.10 miles north of Northside Parkway
S. R. 3; U.S. 41 (Northside Parkway)	A point 0.10 miles north of Northside Drive	Cobb County Line
S. R. 8; U. S. 78/278 (Bankhead Highway)	Cobb County Line	Northside Drive
S. R. 8; U. S. 29/78/278 (North Avenue)	State Route 3/US 19/29/41 (Northside Drive)	Piedmont Avenue
S. R. 8 (Ponce De Leon Avenue)	Piedmont Avenue	Dekalb County Line
S. R. 9; U. S. 19 (14th Street)	Northside Drive	West Peachtree Street
S. R. 9; U. S. 19 (West Peachtree Street)	14th Street	Peachtree Street
S. R. 9; U. S. 19 (Peachtree St./Rd.	West Peachtree Street	Roswell Road
S. R. 9; U. S. 19 (Roswell Road)	Peachtree Road	A point 50 feet north of Meadowbrook Drive
S. R. 9; SOUTH (Spring Street)	Peachtree Street	14th Street
S. R. 10 (Freedom Pkwy.)	State Route 401/I-75	State Route 8/Ponce de Leon Avenue
S. R. 13 (Buford Highway)	Peachtree Road	Dekalb County Line
S. R. 14; U. S. 29 (Lee Street)	A point 0.05 miles north of Womack Avenue (East Point city limits)	Avon Avenue
S. R. 14; U. S. 29 (Lee Street/ West Whitehall Street)	Avon Avenue	Chapel Street
S. R. 14 (West Whitehall Street/Peters Street)	Chapel Street	Spring Street
S. R. 42; U. S. 23 (Moreland Avenue)	Dekalb County Line	A point 0.10 miles south of Custer Avenue
S. R. 42; U. S. 23 (Moreland Avenue)	A point 0.10 miles south of Custer Avenue	Ponce de Leon Avenue
S. R. 42; (Briarcliff Road)	Ponce de Leon Avenue	Dekalb County Line
S. R. 42 CONN. (Freedom Parkway Connector)	State Route 10	State Route 42
S. R. 42 SPUR (McDonough Boulevard)	Moreland Avenue	Jonesboro Road
S. R. 54 (Jonesboro Road)	Clayton County Line	Harper Road

S. R. 54 (Jonesboro Rd., McDonough Blvd., University Ave.)	Harper Road	State Route 401/I-75
S. R. 54 CONN. (Sawtell Avenue)	Jonesboro Road	McDonough Blvd.
S. R. 70 (Fulton Industrial Blvd.)	Aviation Circle	Bankhead Highway
S. R. 139 (Ralph David Abernathy Boulevard)	State Route 14/US 29/ W. Whitehall Street	Martin Luther King Jr. Drive
S. R. 139 (Martin Luther King Jr. Drive)	Ralph David Abernathy Drive	A point 0.10 mile west of Old Gordon Road
S. R. 141 (Peachtree Road)	State Route 9	Dekalb County Line

STATE ROUTE	FROM	TO
S. R. 3; U.S. 19/41 (Metropolitan Parkway)	A point 50 feet north of Mt. Zion Road (Hapeville city limits)	Northside Drive
S. R. 3 ; U.S. 19/29/41 (Northside Drive)	Metropolitan Parkway	A point 0.10 miles north of Northside Parkway
S. R. 3; U.S. 41 (Northside Parkway)	A point 0.10 miles north of Northside Drive	Cobb County Line
S. R. 8; U. S. 78/278 (Bankhead Highway)	Cobb County Line	Northside Drive
S. R. 8; U. S. 29/78/278 (North Avenue)	State Route 3/US 19/29/41 (Northside Drive)	Piedmont Avenue
S. R. 8 (Ponce De Leon Avenue)	Piedmont Avenue	Dekalb County Line
S. R. 9; U. S. 19 (14th Street)	Northside Drive	West Peachtree Street
S. R. 9; U. S. 19 (West Peachtree Street)	14th Street	Peachtree Street
S. R. 9; U. S. 19 (Peachtree St./Rd.	West Peachtree Street	Roswell Road
S. R. 9; U. S. 19 (Roswell Road)	Peachtree Road	A point 50 feet north of Meadowbrook Drive
S. R. 9; SOUTH (Spring Street)	Peachtree Street	14th Street
S. R. 10 (Freedom Pkwy.)	State Route 401/I-75	State Route 8/Ponce de Leon Avenue
S. R. 13 (Buford Highway)	Peachtree Road	Dekalb County Line
S. R. 14; U. S. 29 (Lee Street)	A point 0.05 miles north of Womack Avenue (East Point city limits)	Avon Avenue
S. R. 14; U. S. 29 (Lee Street/ West Whitehall Street)	Avon Avenue	Chapel Street
S. R. 14 (West Whitehall Street/Peters Street)	Chapel Street	Spring Street
S. R. 42; U. S. 23 (Moreland Avenue)	Dekalb County Line	A point 0.10 miles south of Custer Avenue
S. R. 42; U. S. 23 (Moreland Avenue)	A point 0.10 miles south of Custer Avenue	Ponce de Leon Avenue
S. R. 42; (Briarcliff Road)	Ponce de Leon Avenue	Dekalb County Line
S. R. 42 CONN. (Freedom Parkway Connector)	State Route 10	State Route 42
S. R. 42 SPUR (McDonough Boulevard)	Moreland Avenue	Jonesboro Road
S. R. 54 (Jonesboro Road)	Clayton County Line	Harper Road
S. R. 54 (Jonesboro Rd., McDonough Blvd., University Ave.)	Harper Road	State Route 401/I-75
S. R. 54 CONN. (Sawtell Avenue)	Jonesboro Road	McDonough Blvd.
S. R. 70 (Fulton Industrial Blvd.)	Aviation Circle	Bankhead Highway
S. R. 139 (Ralph David Abernathy Boulevard)	State Route 14/US 29/ W. Whitehall Street	Martin Luther King Jr. Drive
S. R. 139 (Martin Luther King Jr. Drive)	Ralph David Abernathy Drive	A point 0.10 mile west of Old Gordon Road
S. R. 141 (Peachtree Road)	State Route 9	Dekalb County Line

Appendix C:

Collector Streets

Alphabetical Listing

Note: Streets listed may also be classified as State or Federal Highways and may be identified by a highway number designation.

STREET NAME	SEGMENT	Miles
Alexander Street, N.E.	Marietta Street to West Peachtree Street	0.47
Arizona Avenue, N.E.	Rogers Street to Dekalb Avenue	0.1
Ashby St, S.W. & N.W.	White Street to West Marietta Street	3.5
Atlanta Avenue, S.E.	Capitol Avenue to Boulevard	1.1
Auburn Avenue, N.E.	Peachtree Street to Randolph Street	1.5
Auburn Avenue, N.E.	Randolph Street to Port Street	0.6
Avon Avenue, S.W.	Lee Street to Cascade Avenue	1.5
Austin Avenue, N.E.	Euclid Avenue to Elizabeth Street	0.3
Bakers Perry Road, S.W.	City Limits to M.L.K. Jr. Dr.	2.0
Baker Road, N.W.	Hightower Road to West North Avenue	0.9
Barge Road, S.W.	Stone Road to Fairburn Road	1.4
Barnett Street, N.E.	Ponce De Leon Avenue to Virginia Avenue	0.6
Beecher Street, S.W.	Donnelly Ave to Benjamin E Maya Drive	2.55
Benjamin E. Mays DR SW	Beecher Road to Fairburn Road	2.95
Berne Street, S.E.	Boulevard South East to Moreland Avenue	1.11
Beverly Road, N.E.	West Peachtree Street to Polo Drive	0.7
Bishop Street, N.E.	Howell Mill Road to Mecaslin Street	0.75
Blackland Road, N.E.	Roswell Road to Northside Drive	1.4
Bohler Road, N.W. ~	West Wesley Road to Defoors Perry Road	1.1
Bolton Road, N.W. - I	Barrett Road. To M.L.K. Dr. Drive	2.2
Bolton Road, N.W.	Coronet Way to Marietta Boulevard	0.3
Bouldercrest Drive, S.E.	Flat Shoals Road to Fayetteville Road	0.85
Boulder Park, S.W.	Fairburn Road to Mendell Drive	1.9
Boulevard, S.E.	North Avenue to Edgewood Avenue	1.1
Boulevard, S.E.	McDonough Blvd to Glenwood Avenue	1.95
Boulevard Drive, N.E.	Moreland Avenue to Candler Road	3.4
Brown Mills Rd, SW & SE	Crown Road to Jonesboro Road	4.2
Butler Street, N.E.	Houston St. to Martin Luther King Jr. Dr.	0.7
Butler Road, S.W.	Tell Road to Campbellton Road	1.3
Carroll Drive, N.W.	Chattahoochee Avenue to Marietta Road	0.6
Centra Villa Drive, S.W.	Cascade Avenue to Campbellton Road	1.0
Chappell Road, N.W.	Bankhead Hwy to M.L.King Jr. Dr.	1.2
Chattahoochee Ave, N.W.	Howell Mill Road to Marietta Boulevard	1.0
Cherokee Avenue, S.E.	Memorial Drive to Atlanta Avenue	1.1
Childress Drive, S.W.	Cascade Road to Campbellton Road	1.6
Claire Drive, S.W.	Lakewood Avenue to Pryor Road	0.85
Clifton Road, N.E.	Ponce De Leon Avenue to Dekalb Avenue	0.8
College Avenue, N.E.	Howard Street to City Limits	0.8
Collier Drive, N.W.	Old Gordon Road to Hightower Road	2.7
Collier Road, N.W.	Defoor Hills Road to Peachtree Street	2.4
Confederate Avenue, S.E.	Boulevard South East to Edie Avenue	0.75
Conley Road, S.E.	Jonesboro Road to City Limits	0.7

Constitution Road, S.E.	Jonesboro Road to Macon Highway	1.0
Continental Colony Pkwy S.W.	Greenbriar Parkway to Hogan Road	0.6
County Line Road, S.W.	City Limits to City Limits	0.4
County Line Road, S.W.	Tell Road to City Limits	1.8
Custer Avenue, S.E.	Moreland Avenue to Boulevard	1.1
Defoor Avenue N.W.	Howell Mill Road to Collier Road	1.1
Defoor Ferry Road, N.W.	Collier Road to Coronet Way	1.9
Delmar Lane, N.W.	On Ramp to I-285 East Bound	0.9
Delow Drive, S.W.	Campbellton Road to Cascade Avenue	1.3
Derring Road, N.W.	Northside Drive to Peachtree Street	1.0
Dill Avenue, S.W.	Murphy Avenue to Stewart Avenue	0.9
Dodson Drive, S.W.	City Limits to Cascade Road	1.6
Donnelly Avenue, S.W. -	Lee Street to Cascade Avenue	1.2
East Andrews Drive, N.E.	Roswell Road to West Paces Ferry Road	0.4
East Confederate Ave, S.E.	Edie Avenue to Moreland Avenue	0.8
East Morningside Dr, N.E.	Piedmont Ave to East Rock Spring Rd	0.8
East Paces Ferry Rd, N.E.	Piedmont Road to Roxboro Road	1.15
East Rock Spring Rd, N.E.	Morningside Drive to City Limits	0.8
East Wesley Road, N.E.	Piedmont Road to Peachtree Road	1.3
Ellis Street, N.E.	Piedmont Avenue to Peachtree Street	0.3
Empire Boulevard, S.W.	Oak Drive to Brown Mills Road	0.85
Euclid Avenue, N.E.	Moreland Avenue to Austin Avenue	0.2
Fair Street, S.W.	Walker Street to Lawton Street	1.15
Fairburn Road, S.W.	City Limits to Bolton Road	3.35
Fairburn Road, S.W.	City limits to City Limits	4.1
Fayetteville Road, S.E.	Flat Shoals Road to Bouldercrest Drive	0.65
Flat Shoals Avenue, S.E.	Moreland Avenue to Bouldercrest Drive	1.1
Fiat Shoals Road, S.E.	Bouldercrest Drive to Fayetteville Road	0.85
Forrest Park Road, S.E.	Thomasville Drive to Conley Road	3.5
Forsyth Street, N.W.	Whitehall Street to Peachtree Street	0.9
Fort Street, N.E.	Irwin Street to Auburn Avenue	0.2
Fulton Street, S.E.	Capitol Avenue to Connally Street	0.35
Fulton Street, S.W. -	Humphries Street to Pryor Street	0.6
Garmon Road, N.W.	Mount Paran Road to City Limits	0.6
Georgia Avenue, S.E.	Capitol Avenue to Cherokee Avenue	0.75
Gilbert Road, S.E.	Brown Mills Road to City Limits	1.1
Glen Irish Drive, N.E.	Highland Ave to Ponce De Leon Avenue	0.8
Gordon Street, S.W.	Martin Luther King Jr. Dr to Cascade	1.1
Greenbrier Parkway, S.W.	Campbellton Road to Barge Road	1.4
Habersham Road, N.E.	Peachtree Battle Avenue to Roswell Road	2.8
Harbin Road, S.W.	Cascade Road to Campbellton Road	1.3
Hapeville Road, S.W.	Cleveland Avenue to Oak Drive	0.8
Harwell Road, N.W.	Bankhead Highway to Collier Drive -	1.3
Hemphill Avenue, N.W.	Northside Drive to 10th Street	0.40
Hill Street, S.E.	Milton Avenue to Glenwood Avenue	1.65
Hills Avenue, N.W.	Chattahoochee Ave to Defoor Hills Road	0.4
Hillside Drive, N.E.	Powers Ferry Road to Northside Drive	0.8
Highland Avenue, N.E.	Alaska Avenue to Piedmont Avenue	1.14
Hightower Road, N.W.	Bankhead Hwy to James Jackson Pkwy	1.1
Hogan Road, S.W.	City Limits to Continental Colony Pkwy	0.4
Hogan Road, S.W.	Fairburn Road to Stone Road	1.2

Hollywood Road, N.W.	Bolton Road to Bankhead Highways	3.0
Houston Street, N.E.	Butler Street to Peachtree Street	0.4
Howard Street, N.E.	College Avenue to Boulevard Drive	0.6
Huff Road, N.E.	Howell Mill Road to Marietta Boulevard	1.0
Hutchens Road, S.E.	Forrest Park Road to Jonesboro Road	1.1
Irwin Street, N.E.	Lake Avenue to Fort Street	1.0
Jackson Street, N.E.	Decatur Street to Highland Avenue,	0.7
James P Brawley Dr., S.W.	Greensferry Avenue to Bankhead Highway	1.75
Jefferson Street, N.W.	Ashby Street to South West Connector	0.45
Jett Road, N.E.	Powers Ferry Road to City Limits	0.6
Johnson Road, N.W.	Hollywood Road to Perry Boulevard	1.3
Johnson Road, N.E.	Lenox Road to Briar Cliff Road	0.8
Kimberly Road, S.W.	Campbellton Road to Melvin Drive	0.9
Kimberly Road, S.W.	City Limits to City Limits	0.59
Lake Avenue, N.E.	Elizabeth Street to Irwin Street	0.4
Lake Forrest Drive, NW.	Powers Ferry Road to City Limits	2.6
Lakewood Avenue, S.E.	Claire Drive to Milton Avenue	1.1
Lakewood Way, S.E.	Pryor Road to Lakewood Avenue	0.4
Langston Avenue, S.W.	Sylvan Road to Murphy Avenue	1.0
Lawton Street, S.W.	Fair Street to Donnelly Avenue	1.15
Lee Street, S.W.	White Street to West End Avenue	0.8
Lenox Road, N.E.	Cheshire Bridge Road to East Rock Spring	1.45
Lenox Road, N.E.	Peachtree Road to Buford Highway	1.8
Linkwood Road, N.W.	Collier Dr to Martin Luther King Jr. Drive	0.7
Luckie Street, N.W.	North Avenue to Forsyth Street	1.1
Lynhurst Drive, S.W.	Martin Luther King Jr. Dr to Cascade Road	2.2
McDaniel Street, S.W.	Northside Drive to University Avenue	1.7
McLendon Avenue, N.E.	Moreland Avenue to City Limits	1.8
McWilliam Road, S.E.	Brown Mills Road to Forrest Park Road	0.75
Macon Drive, S.W.	Mount Zion Road to Cleveland Avenue	0.6
Marietta Road, N.W.	Perry Boulevard to Bolton Road	2.7
Mason Turner Road, S.W.	Simpson Road to Chappell Road -	0.19
Maynard Terrace, S.E.	Glenwood Avenue to Memorial Drive	0.5
Mecasin Street, N.E.	Bishop Street to Derring Road	0.2
Milton Avenue, S.E.	Capitol Avenue to Hill Street	0.7
Mitchell Street, S.W.	Martin Luther King Jr., Dr to Magnum St.	0.4
Moore's Mill Road, N.W.	Bolton Road to West Paces Ferry Road	3.4
Montgomery Ferry Rd, N.E.	Polo Drive to Piedmont Ave	0.6
Monroe Drive, N.E.	Piedmont Cir to Ponce De Leon Ave	3.1
Mount Gilead Road, S.W.	Fairburn Road to Campbellton Road	1.2
Mount Paran Road, N.W.	City Limits to Paces Ferry Road	2.9
Mount Zion Rd, S.W. & S.E.	Stewart Avenue to Brown Mills Road	1.4
Murphy Avenue, S.W.	Glenn Street to Dill Avenue	1.55
Niskey Lake Road, S.W.	Campbellton Road to County Line Road	1.14
North Avenue, N.E.	Bonaventure Avenue to Oakdale Road	1.1
North Highland Ave, N.E.	East Rock Spring to Alaska Avenue	2.95
Northside Drive, N.W.	Northside Parkway to City Limits -	3.0
Northwest Drive, N.W.	Bolton Road to Hightower Road	1.45
Oakdale Road, N.E.	Dekalb Avenue to City Limits	1.35
Oakland Drive, S.W.	Richland to Campbellton Road	0.8
Old Ivy Road, N.E.	Piedmont Road to Wieuca Road	1.2
Old Hapeville Road, S.W.	Macon Drive to Cleveland Avenue	0.6

Ormond Street, S.E.	Cherokee Avenue to Capitol Avenue	0.75
Parkway Drive, N.E.	Highland Ave to Ponce De Leon Avenue	0.8
Parrott Avenue, N.W.	Bolton Road to Bolton Road	1.0
Peachtree Battle Ave, N.W.	Moore's Mill Road to Peachtree Road	3.2
Peachtree Center Ave N.E.	Edgewood Avenue to Peachtree Street	0.6
Perkerson Road, S.W.	Stewart Avenue to Sylvan Road	1.3
Perry Boulevard, N.W.	Southwest Connector to Hollywood Road	2.9
Peyton Road, S.W.	Benjamin E Mays Drive to M.L.K. Jr. Drive	2.2
Pharr Road, N.E.	Peachtree Road to Piedmont Road	0.75
Piedmont Circle, N.E.	Piedmont Avenue to Monroe Drive	0.1
Polo Drive, N.E.	Beverly Road to Montgomery Ferry Road	0.2
Poole Creek Road, S.W.	Jonesboro Road to Brown Mills Road	1.6
Powers Ferry Road, N.W.	Roswell Road to City Limits	1.9
Pryor Road, S.W.	University Avenue to Lakewood Way	1.6
Ralph McGill Blvd, N.E.	North Avenue to Peachtree Street	2.2
Randolph Street, N.E.	Auburn Avenue to Highland Avenue	0.35
Ridgewood Road, N.W.	Paces Ferry Road to Moore's Mill Road	2.5
Rogers Street, N.E.	Boulevard Drive to Arizona Avenue	0.5
Sandtown Road, S.W. -	Venetian Drive to Cascade Road	1.0
Simpson Road, N.W.	Collier Road to Marietta Street	4.2
S. River Industrial Blvd SE	Forrest Park Road to City Limits	0.6
Stone Hogan Connector SW	Stone Road to City Limits	0.4
Stone Road, S.W.	Fairburn Road to City Limits	1.8
Sydney Street, S.E.	Connelly Street to Cherokee Avenue	0.4
Sylvan Road, S.W.	Murphy Avenue to City Limits	1.9
Techwood Drive, N.W.	10th Street to 16th Street	0.6
University Avenue, S.W.	Stewart Avenue to Ridge Avenue	1.1
Veltre Circle, S.W.	Cascade Road to Benjamin E Mays Drive	0.7
Venetian Drive, S.W.	Cascade Avenue to Campbellton Road	2.0
Virginia Avenue, N.E.	North Highland Avenue to Monroe Drive	0.75
Waters Road, S.W.	Cleveland Avenue to Hapeville Road	0.4
Wells Street, S.W.	Glenn Street to Humphries Street	0.3
West Lake Avenue, N.W.	Bankhead Hwy to MLK Jr. Dr.	1.5
West North Avenue, N.W.	Baker Road to Chappell Road	1.35
West Peachtree Place, NW	Alexander Street. to Peachtree Street	0.38
West Wesley Road, N.W.	Peachtree Road to Ridgewood Road	3.9
West Wieuca Road, N.W.	Loridans Drive to Lake Forrest Drive	0.9
Westmont Road, S.W.	Venetian Drive to Beecher Street	1.3
Westview Drive, N.W.	Cordon Street to West End Avenue	1.7
Weyuian Avenue, S.W.	Capitol Avenue to Ridge Avenue	0.1
White Street, S.W.	Cordon Street to Ashby Street	0.95
Whitefoord Avenue, N.E.	Memorial Drive to Dekalb Avenue	1.0
Wieuca Road, N.E.	Peachtree Road to Loridans Drive	1.6
Willis Mill Road, S.W.	Cascade Road to Campbellton Road	1.3
Wyman Street, N.E.	Memorial Drive to Boulevard Drive	0.4
Zip Industrial, S.E.	Poole Creek Road to Brown Mills Road	0.7
10th Street, N.W.	Monroe Drive to Howell Mill Road	2.4
14th Street, N.W.	Howell Mill Road to Juniper Street	1.7

TOTAL # of Streets = 195

Total # of Miles 246.67

Appendix D:

Time of Day Restrictions for working in the right-of-way

Noted: Include working in inclement weather section

In an effort to minimize the negative effects of noise and traffic congestion caused by construction activities, Time of Day Limitations are imposed on construction activities in certain area of the City.

Unless specifically stipulated otherwise by a written permit from the City of Atlanta:

- No lane of any arterial street shall be blocked for any period between 7:00 AM and 9:00 AM or between 4:00 PM and 6:00 PM.
- No lane of any arterial street shall be blocked for any period exceeding 1 hour between 9:00 AM and 4:00 PM unless a uniformed police officer is employed on site to direct traffic.
- No lane of any street in a commercial or retail zone shall be blocked for any period exceeding 1 hour between 7:00 AM and 6:00 PM.
- No nighttime activities in residential areas, define language 10:00 PM to 7:00 AM excluding maintenance that does not exceed – define levels which requires a noise variance. 74.135 Section
- No activities that create an unacceptable level of noise, dust, or disruption to normal activities of the population

Exceptions to Time of Day Restrictions

In the event of a legitimate emergency, time of day restrictions may be waived.

Emergency

In order to be recognized as an emergency for the waiver of time of day restrictions one or more of the following restrictions must exist:

- Immediate danger to life, health, or property.
- Immediate threat of environmental damage.
- Necessity to repair damage to essential facilities resulting from extreme weather events or traffic accidents.
- Loss of service to customers.
- Immediate response to the problem will result in significantly reduced inconvenience to the public in the long term.
- Delay of repair will result in further damage to facilities.
- Other extraordinary condition that can be documented as an emergency.

Within 24 hours of the occurrence of the emergency, or at the beginning of the next business day, the facility owner must notify the Department of Public Works of the location and nature of the emergency and submit the following as appropriate:

Permit has to be submit within 5 days

- Notice and explanation of any threat to public health or safety.
- Notice and explanation of any threat of environmental damage.
- An engineering plan meeting the Department of Public Works standards, illustrating the work done or remaining to be done.
- A schedule of activities.
- Payment of applicable fees

Additional requirements may apply, depending on the specific circumstances of the event.

SECTION 01600

GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. All installed materials and equipment are to be the latest version of the manufacturers product line and not be outdated by newer versions at the time of purchasing. Materials and equipment, which show any signs of extended storage such as corrosion, scratches and dents, will not be accepted for installation in this project.
- B. All equipment used for performing the Work shall conform to the latest version of all applicable safety standards including but not limited to OSHA requirements. Contractor shall not exceed or ignore any requirements or recommendations of the equipment manufacturer. Equipment not meeting requirements of this Section will be barred from use on the project.
- C. All installed material and equipment shall meet or exceed the latest applicable code requirements including but not limited to, Underwriters Laboratory, Standard Building Code and OSHA, as well as requirements of these Specifications. Where there is conflict with requirements of the Contract Documents and code requirements, comply with the more stringent requirements with no additional compensation to the Contractor.

PART 2 - MATERIALS AND EQUIPMENT

2.1 ANCHOR BOLTS

- A. All anchor bolts to be ANSI type 316 stainless steel unless otherwise specified or indicated, and must conform to requirements of this Section and the material articles in the appropriate Sections they are used.
- B. All anchor bolts are to be supplied by the manufacturer or fabricator of the specific material or equipment to be installed.
- C. Design criteria for anchor bolts
 - 1. When the size, length or load carrying capacity of an anchor bolt, expansion anchor, or concrete insert is not shown on the Drawings, provide the size, length and capacity required to carry the design load times a minimum safety factor of four.
 - 2. Determine design loads as follows:
 - a. For equipment anchors, use the design load recommended by the manufacturer and approved by the Engineer.

- b. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides.
- c. Allowances for vibration are included in the safety factor specified above.

Bolt Diameter (Inches)	Min. Shear (Pounds)	Min. Pull-Out Load (Pounds)
1/2	4,500	6,300
5/8	6,900	7,700
3/4	10,500	9,900

- 3. Embedment depth to be 6 inches for epoxy anchors unless noted otherwise on the drawings. Expansion anchors shall be embedded sufficiently to place the wedge portion of the bolt a minimum of 1-inch behind the reinforcing steel within the concrete but a minimum of 4 inches, unless noted otherwise on the drawings.

D. Anchor Type and Manufacturer

- 1. Where epoxy anchors are noted on the drawings, provide ANSI type 316 stainless steel threaded rod with Speed Bond #1 epoxy injection as manufactured by Prime Resins, Inc. or equal.
- 2. For all other applications, provide ANSI type 316 steel expansion anchors from one of the following manufacturers.
- 3. Hilti, Incorporated.
- 4. Ramset, Incorporated.
- 5. Or equal.
- 6. Install anchors per manufacturer's recommendations and this Section.
Drilled anchorage holes are to be blown out with compressed air before installing anchor.

2.2 CONNECTION BOLTS

- A. Materials shall be as specified in other Sections of the Specifications, or as shown on the Drawings. Where materials are not specified or shown on the Drawings, they shall be of ANSI Type 316 stainless steel, with ANSI Type 316 stainless steel nuts and washers.
- B. Unless otherwise specified, stud, tap and machine bolts and nuts shall be ANSI Type 316 stainless steel and shall conform to the requirements of ASTM Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307-80. Hexagonal nuts of

the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).

2.3 CONCRETE INSERTS

Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for hangers shall be of a type, which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized, then epoxy phenolic primed and top coated with PVC, using thermal bond process.

2.4 ELECTRICAL EQUIPMENT ENCLOSURES

All items of electrical equipment that are furnished with process equipment shall conform to the requirements specified under the appropriate electrical sections of the specifications. Enclosures for electrical equipment such as switches, starters, etc., shall conform to the requirements specified under the appropriate electrical sections of the specifications.

2.5 EQUIPMENT DRIVE GUARDS

All equipment driven by open shafts, belts, chains, or gears shall be provided with acceptable all-metal guards enclosing the drive mechanism, unless otherwise indicated on the Drawings or relevant equipment specification. Guards shall be constructed of epoxy paint coated, galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps, which will permit easy removal for servicing the equipment. The guards shall conform in all respects to all applicable safety codes and regulations.

2.6 NAMEPLATES

- A. Each piece of equipment shall be provided with a substantial nameplate of non-corrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate.
- B. This requirement shall not apply to standard, manually operated gate, globe, butterfly, diaphragm, ball, and plug valves.
- C. Each process valve shall be provided with a substantial tag of corrosion resistant metal securely fastened in place and inscribed with an identification number in conformance with the tag numbers indicated on the Process and Instrumentation Drawings.

2.7 LUBRICANTS

During testing and prior to acceptance, the Contractor shall furnish all lubricants necessary for the proper lubrication of all equipment furnished under this contract.

2.8 PROTECTION AGAINST ELECTROLYSIS

Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

2.9 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

A. Packing and Shipping:

1. Product and materials shall be shipped and handled in ways which will prevent damage.
2. Equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to the project site. Bearing housing, vents and other types of openings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt.
3. Ship equipment, material, and spare parts in assembled units except where partial disassembly is required by transportation regulations or for protection of components.
4. Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.
5. Stiffeners shall be used where necessary to maintain shapes and to give rigidity.
6. Each item or package shall be marked with the number unique to the specification reference covering the item. Spare parts shall be packed in containers bearing labels clearly designating contents and pieces of equipment for which intended.

B. Acceptance at Site:

1. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Engineer.
2. Damage shall be corrected to conform to the requirements of the Contract before the assembly is incorporated into the Work.
3. The Contractor shall bear the costs arising out of dismantling, inspection, repair, and reassembly.

- C. Storage and Protection:
1. During the interval between the delivery to the site and installation, equipment and materials shall be stored in an enclosed space affording protection from weather, dust, and mechanical damage and providing favorable temperature, humidity, and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.
 2. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.

2.10 UNIT RESPONSIBILITY

- A. Equipment systems made up of two or more components shall be provided as a unit by the responsible manufacturer. Unless otherwise specified, the Contractor shall obtain each system from the supplier of the driven equipment, which supplier shall provide all components of the system to enhance compatibility, ease of construction, and efficient maintenance. The Contractor shall be responsible to the City for performance of all system in accordance with the provisions of the General Conditions of the Contract Documents.
- B. Where the detailed specifications require the Contractor to furnish a certificate of unit responsibility, such certificate shall be executed by the manufacturer. No other submittal material shall be processed until the Certificate of Unit Responsibility has been received and has been found to be satisfactory. A typical Manufacturer's Certificate of Unit Responsibility form is included in this specification.

2.11 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Where manufacturers' services are specified, Contractor shall furnish an authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system to perform these services. Additional qualifications of the manufacturer's representative may be specified elsewhere. Where time is necessary in excess of that stated in the Specifications for the manufacturers' service representative to complete the specified services, the additional time required to perform the services shall be considered incidental work for which the Contractor will receive no additional compensation.

- B. After installation of the listed equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the representative shall inspect, operate, test and adjust the equipment. The inspection shall include, but shall not be limited to, the following points as applicable:
1. Soundness (without cracked or otherwise damaged parts).
 2. Completeness in all details, as specified.
 3. Correctness of setting, alignment, and relative arrangement of various parts.
 4. Adequacy and correctness of packing, sealing and lubricants.
- C. The operation, testing and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.
- D. On completion of its work, the manufacturer's or supplier's representative shall submit in triplicate to the Engineer Certificate Submittals in accordance with sub-paragraph L of this paragraph and a complete signed report of the result of his inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
- E. After the Engineer has reviewed the reports from the manufacturers' representative, the Contractor shall make arrangements to have the manufacturers' representatives present when the field acceptance tests are made.
- F. Requirements of this paragraph will be in addition to those of appropriate equipment and material Sections.
- G. Fulfillment of Specified Minimum Services
1. Only those manufacturers' services, including trips to the jobsite or training classroom, receiving prior written acceptance or authorization by the Engineer shall act to fulfill the specified services.
 2. If manufacturer's representative is found deficient in training or experience by the Engineer, furnish other acceptable representatives after acceptance of resumes and other documentation of proposed representatives.
- H. Proper Installation of Products and Systems

Furnish manufacturers' representatives of products and systems. Representatives shall resolve assembly or installation problems attributable to, or associated with, their products and systems, whether or not specifically required in the Specifications.

I. Functional Testing

1. Where functional (or run) testing is required in the Specifications, furnish manufacturer's representative to assist with the test. This shall include checking for proper rotation, alignment, speed, excessive vibration, and quiet operation. Perform initial equipment and system adjustment and calibrations in the presence and with the assistance of the manufacturer's representative.
2. Obtain manufacturer's review and acceptance of Contractor's certification of functional testing, where such certification is specified.

J. Performance Testing

1. Where performance testing is specified, furnish manufacturer's representative to assist the test as specified for the particular equipment, and to correct malfunction of equipment. Follow specified test procedures.
2. These services shall continue until:
 - a. Equipment or systems have been successfully tested for performance.
 - b. Performance test report has been reviewed and accepted.
 - c. Equipment or systems have been accepted by Engineer for startup.
3. Unless otherwise specified, performance testing shall use plant fluid or material that the equipment or system is designed to handle during normal service conditions.

K. Training of City's Personnel

1. Additional training requirements are specified in Section 01664, Training, and individual equipment specifications.
2. Designate and provide Contractor's personnel to be responsible for coordinating and expediting training duties. The person(s) shall be present during training coordination meetings with the Engineer and shall be familiar with the Operation and Maintenance (O & M) Manual information specified in the General Conditions of the Contract Documents.
3. Training services shall be performed by an approved manufacturer's representative and shall include pre-startup classroom instruction, post startup classroom instruction, and onsite equipment instruction, as stated in the Specifications.
4. Pre-startup Training: Coordinate pre-startup training periods with Owner's operating personnel and manufacturers' representatives, and with submittal of O & M Manuals.

- a. Pre-startup training shall be completed at least 14 days prior to actual startup.
 - b. O&M Manuals shall be reviewed, accepted, and resubmitted, in accordance with Section SUBMITTALS, before startup.
- 5. Post Startup Training: Where post startup training is required in the Specifications, furnish and coordinate the specified manufacturers' services and Contractor's personnel for post startup training of Owner's operating personnel.

L. Certificate Submittals

The forms included with this Section are to be used by the Contractor and by manufacturers of systems and products to certify proper installation, completion of functional testing, and performance testing results following successful completion of these requirements.

**MANUFACTURER'S CERTIFICATE
OF
PROPER INSTALLATION**

Contractor: _____

Equipment Name: _____

Equipment Tag Number(s): _____

Specification Section: _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Date: _____ Hours on Site: _____

Purpose: To verify installation recommendations and warranty is valid.

At a minimum, the following items (if applicable) must be checked:

	Yes	No	NA
Equipment serviced with proper lubricants.			
All safety equipment properly installed.			
Proper electrical connections.			
Proper mechanical connections.			
Equipment meets all warranty requirements.			

List additional items checked: (See Detailed Specification Section)

Comments: _____

(List and attach additional pages, if necessary.)

Signatures (Do not initial.)

Contractor: _____

Manufacturer: _____

Engineer: _____

Date: _____

Date: _____

Date: _____

**MANUFACTURER'S CERTIFICATE
OF
FUNCTIONAL TEST ACCEPTANCE INSTALLATION**

Contractor: _____

Equipment Name: _____

Equipment Tag Number(s): _____

Specification Section: _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Date: _____ Hours on Site: _____

Purpose: To verify installation, that proper adjustments have been made, that the equipment or system is ready for plant startup and operation and warranty is valid.

At a minimum, the following items (if applicable) must be checked:

	Yes	No	NA
Rotation			
Alignment			
Speed			
Noise level			
Initial adjustments			
Initial calibration			

List additional items checked: (See Detailed Specification Section)

Comments: _____

(List and attach additional pages, if necessary.)

Signatures (Do not initial.)

Contractor: _____

Manufacturer: _____

Engineer: _____

Date: _____

Date: _____

Date: _____

**MANUFACTURER'S CERTIFICATE
OF
PERFORMANCE TEST ACCEPTANCE**

Contractor: _____

Equipment Name: _____

Equipment Tag Number(s): _____

Specification Section: _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Date: _____ Hours on Site: _____

Purpose: To certify that the equipment or system identified above has been successfully tested for performance and is ready to be accepted by the City for full-time operation.

This certifies that the above equipment or system operated under actual performance conditions, and that the equipment or system meets the specified performance criteria.

Comments: _____

(List and attach additional pages, if necessary.)

Signatures (Do not initial.)

Contractor: _____

Manufacturer: _____

Engineer: _____

Date: _____

Date: _____

Date: _____

**CONTRACTOR'S CERTIFICATE
OF
EQUIPMENT START-UP READINESS**

Contractor: _____

Equipment Name(s): _____

Equipment Tag Number(s): _____

Specification Section: _____

"I, the undersigned, do hereby certify that all of the necessary hydraulic structures, piping systems, and valves have been successfully tested; that all necessary equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are all operational; that the systems and subsystems are capable of performing their intended functions; and that the facilities noted above are ready for startup and intended operation."

Signature Title

Date

**MANUFACTURER'S CERTIFICATE
OF
UNIT RESPONSIBILITY**

Manufacturer: _____

Equipment Name: _____

Specification Section(s): _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Purpose: To certify that the equipment or system manufacturer identified above accepts unit responsibility for equipment or systems furnished.

This certifies that the above equipment or system manufacturer accepts unit responsibility for equipment or systems furnished under the indicated specification section(s) and that the components furnished are compatible and comprise a functional unit suitable for the specified performance and design requirements.

Signatures (Do not initial.)

Contractor: _____

Date: _____

Manufacturer: _____

Date: _____

**MANUFACTURER'S CERTIFICATE
OF
INSTRUCTION CERTIFICATION**

Contract No.: _____

Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment Item: _____

The undersigned manufacturer certifies that a service engineer has instructed the City operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Startup procedure reviewed _____

Shutdown procedure reviewed _____

Normal operation procedure reviewed _____

Others: _____

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency) _____

Described special tools required _____

Described normal items to be reviewed for wear _____

Described preventive maintenance instructions _____

Described greasing frequency _____

Others: _____

Date

Manufacturer

Date

Signature of Authorized Representative

Date

Signature of City's Representative

Date

Signature of Contractor's Representative

+++ END OF SECTION 01600 +++

SECTION 01610

TRANSPORTATION AND HANDLING

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide transportation of all equipment, materials and products furnished under these Contract Documents to the Work site. In addition, the Contractor shall provide preparation for shipment, loading, unloading, handling and preparation for installation and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the Work.
- B. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the City prior to being incorporated into the Work.

1.2 TRANSPORTATION

- A. All equipment shall be suitably boxed, crated or otherwise protected during transportation.
- B. Where equipment will be installed using existing cranes or hoisting equipment, the Contractor shall ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment.
- C. Small items and appurtenances such as gauges, valves, switches, instruments and probes which could be damaged during shipment shall be removed from the equipment prior to shipment, packaged and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.

1.3 HANDLING

- A. All equipment, materials and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation.
- B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice.

- C. Under no circumstances shall equipment or products such as pipe, structural steel, castings, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.
- D. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.

+++ END OF SECTION 01610 +++

SECTION 01650

FACILITY STARTUP

PART 1 - GENERAL

1.1 RELATED SECTIONS (RESERVED)

1.2 DEFINITIONS

- A. Pre-Operational Checkout (Step 1): Are those documented physical checks (tests) that must occur to insure that an item of equipment or equipment system is ready for functional testing. Example components of pre-operational checkout /testing include but are not limited to the following:
1. Pressure and/or leakage tests, water-tightness of concrete structures, and pipe testing.
 2. Electrical testing, resistance testing in accordance with NETA - section 16T. Also, Phase/motor rotation checks.
 3. Instrument calibration and loop tests. Pre-operational check-out of instrumentation system controls.
 4. Pre-operational checkout of mechanical and HVAC equipment to include alignment, lubrication, and other checks as recommended by the manufacturer.
- B. Functional Test: (Step 2): A test or tests, in the presence of the City and/or the City's Engineer, to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements.

The testing of the individual items of equipment within a system will be performed under simulated conditions to determine contract compliance. This test will utilize plant effluent, potable water, or another acceptable substitute test media. The equipment will be operated long enough to gather information (data) on noise, temperature, vibration, performance characteristics, and to make initial adjustments of any applicable controls. Initial baseline data will be gathered on equipment with motors greater than 1 horsepower including amperage, bearing temperatures, and vibration.

The instrumentation and control field testing (loop checks from the field devices to PLC or distributed control systems as well as field calibrations) will be accomplished during the pre-operational checkout and functional testing stages as defined above.

- C. Operational Test (Step 3): A test, performed in the presence of the City and/or the City's Engineer, of all components within a system collectively to insure that the system and all of its integral components function as

intended. Water and/or other temporary media supplied by the Contractor will be circulated through the completed facility/system for 5 days with systems being operated under various loading conditions as proposed by the Contractor and approved by the City's Engineer.

The instrumentation and control system automatic function for the overall system will be verified and documented during the operational testing stage as described above.

- D. Punchlist: All items that could affect, or be affected by, the full time operation of the system (as deemed critical by the City Engineer) must be complete prior to the Operational Test phase.
- E. Acceptance Test (Step 4): The start-up and operation of the systems installed, under actual operating conditions, as part of the actual plant process. The acceptance test period is 30 days. The City's O&M staff will be responsible for running the system with the Contractor's support team being available for assistance 24/7. Upon completion of this commissioning period the Contractor may apply for a Substantial Completion certificate.
- F. Performance Test: Any special tests, performed in the presence of the City and/or the City's Engineer, called for by the specific equipment or system specification which are to be performed in addition to the installation and acceptance tests noted in this start-up specification (pre-operational checkout, functional testing, operational testing, and acceptance testing).
- G. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of systems on this Project are as follows:
 - 1. Pumps, motors, and controls.
 - 2. Instrumentation and control system(s).
- H. Substantial Completion: The date certified by the City Engineer when all or a part of the work has been properly installed per the contract documents and manufacturer recommendations, deemed operational through the completion of the Pre-operational checkout, Functional Test, Operational Test, has all test documents with Operation and Maintenance manuals delivered, is sufficiently completed in accordance with the requirements of the Contract Documents and has been demonstrated through the 30 day Acceptance Test thus proving that the identified portion of the work can reliably be utilized for the purposes for which it is intended.

1.3 SUBMITTALS

- A. Administrative Submittals:
 - 1. Functional and performance test schedules and plan for equipment, units, and systems at least 14 days prior to start of related testing. Include test plan, procedures, and log format.
 - 2. Schedule and plan of facility startup activities at least 21 days prior to commencement.
- B. Quality Control Submittals:
 - 1. Manufacturer's Certificate of Proper Installation as required.
 - 2. Test Reports: Functional and performance testing, in format acceptable to the City Engineer and certification of functional and performance test for each piece of equipment or system specified.
 - 3. Certifications of Calibration: Testing equipment.

1.4 CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

- A. General:
 - 1. The Contractor shall provide, at no expense to the City, all power, fuel, compressed air supplies, water, and chemicals; as well as all labor, temporary piping, heating, ventilating, and air conditioning or bypass pumping, for any areas where the Improved Facilities are not complete and operable at the time of Acceptance Testing and its prerequisites. Contractor shall provide all other items and work required to complete Acceptance Testing and its prerequisites. Temporary facilities shall be maintained until permanent systems are in service.
 - 2. The Contractor shall also provide all necessary qualified operations personnel and manufacturers field service personnel of the major equipment suppliers on an eight hour per day basis at the facilities and on a 24 hour per day basis locally during the operational and acceptance test period.
 - 3. At no time during startup shall the Contractor allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.
- B. Tie-Ins or Modifications To The Existing Systems
 - 1. Anytime the Contractor ties into or modifies an existing system, a detailed work plan shall be required. Submittal of this work plan must be a minimum of 30 days in advance of commencement of the subject work. This work plan shall include a detailed description of the work, a step-by-step plan of the modification or tie-in, a detailed timeline schedule, a detailed list of materials and equipment required, demonstrated communications capacity, and a listing of any gates or valves which must be operated. Working

drawings shall be submitted as required under GC-28 for any permanent or temporary structural modifications. A temporary safety plan covering the period of the work, and a listing of contingency plans and supplies, including but not limited to spill prevention planning and spill containment kits, shall be required. A coordination meeting with the City's plant operating staff, the Contractor and any parties so designated by the City must be held at least 7 days prior to the commencement of the modification or tie-in. The day before the commencement of the modification or tie-in, a final coordination meeting shall be held giving final detailed work assignments to all parties involved.

2. The City has the right to require, at no additional cost to the City, stand-by equipment on any item(s) deemed critical enough to delay the work. The Contractor shall have available stand-by personnel to supplement the committed forces should problems arise. The Contractor is responsible for meeting all OSHA standards including entrance and exit safety, confined space entry, fall protection, scaffolding, rigging, etc.

C. Contractor's Startup Quality Assurance Manager

The Contractor shall appoint an operations engineer or equally qualified operations specialist as Startup Manager to manage, coordinate, and supervise all aspects of the Contractor's startup and testing program including, but not limited to those components of the program as listed with this appendix. The Startup Manager shall have at least five (5) years of total experience, or experience on at least five separate projects, in managing the startup commissioning of mechanical, electrical, instrumentation, HVAC, and piping systems. Operations engineers shall be graduates from a minimum 4-year course in mechanical, civil or a related program of study. Operations specialists shall have equivalent documented experience in plant operation and maintenance. Contractor shall submit the Startup Manager's resume for review and approval a minimum of six months prior to any testing, or prior to 50% completion of the first constructed system.

D. Contractor's Testing Team

1. Contractor's Testing Team shall include at a minimum the Quality Assurance Manager, qualified Mechanical/Equipment Foreman, qualified Electrical Journeyman, qualified Instrument Technician, and qualified/Certified Plant Operations personnel.
2. Contractor is responsible to have the appropriate personnel, procedures, and test forms at the test site when performing a scheduled checkout/testing activity that is to be witnessed by the City Engineer.

E. Test Equipment

1. All test equipment (gauges, meters, thermometers, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under this contract shall be calibrated to within plus or minus two (2) percent of actual value at full scale. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale. Pressure gages shall be calibrated in accordance with ANSI/ASME B40.1. Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a certified calibration curve.
2. Test instruments shall be calibrated to references traceable to the National Bureau of Standards and shall have a current sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required.
3. Calibration equipment/test instruments utilized for start-up and testing shall be documented to include identification (by make, manufacturer, model, and serial number) of the test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory as well as documentation of current calibration.
4. All analysis instruments, sensors, gauges, and meters used for performance testing shall be subject to recalibration to confirm accuracy after completion, but prior to acceptance of each performance test. All analysis instruments, sensors, gages, and meters installed under this contract shall be subject to recalibration prior to Acceptance.
5. Test equipment used to simulate inputs and read outputs shall have a rated accuracy at the point of measurement at least three times greater than the component under test. Buffer solutions and reference fluids shall be provided as necessary for tests of analytical equipment.

1.5 OWNER/ENGINEER FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review Contractor's test plan and schedule.
2. Witness each functional, operational (portions of) and performance test.
3. Coordinate other plant operations, if necessary, to facilitate Contractor's tests.

B. Startup Test Period:

1. Operate process units and devices, with support of Contractor.

2. Provide sampling, labor, and materials as required and provide laboratory analyses.
3. Make available spare parts and special tools and operation and maintenance information for Owner-furnished equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - PART 3 – EXECUTION

3.1 START-UP PROGRAM IMPLEMENTATION

A. Start-Up Meetings

1. The Contractor shall schedule and conduct regular periodic start-up meetings (separate from regular progress meetings). The start-up meetings will be held at least every 10 days (once start-up planning commences) and may be scheduled at a more frequent interval by the City Engineer if necessary. Start-up meetings shall be held at a location designated by the Contractor and approved by the City Engineer.
2. Start-up meetings shall be attended by the City Engineer, Contractor, Subcontractors as appropriate to the agenda, suppliers as appropriate to the agenda and others as required.
3. The meeting agenda shall generally include review and approval of minutes of previous meeting, review of start-up progress since the previous meeting, field observations, problems, and conflicts, problems which impede Start-Up Schedule, delivery schedules, corrective measures and procedures to regain the start-up schedule, revisions to Start-Up Schedule, progress and schedule of the preceding work period, coordination of schedules, review of start-up submittal schedules and status, status of start-up related requests for information, and any other business deemed appropriate.

B. Start-up and Testing Schedule

1. The Contractor shall produce an overall testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be in bar chart form, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with the Construction Schedule. The testing schedule shall show the contemplated start date, duration of the test and completion of each test.
2. The preliminary test schedule shall be submitted with the overall Start-up Acceptance Test Plan. The City Engineer will not witness any testing work until the Contractor has submitted a schedule to which the City Engineer takes no exception. The test schedule shall be updated weekly, and presented at each start-up meeting, showing actual dates of test work, indicating systems and

equipment testing completed satisfactorily and meeting the requirements of the Contract Standards, and also re-forecast the upcoming testing and reflect any schedule adjustments accompanied by written reason for the change. The Contractors baseline start-up and testing schedule is to be submitted with the overall test plan.

C. Documentation

1. The Contractor shall develop a records-keeping system to document all activities associated with Acceptance Testing and its prerequisites.
2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for witness by the City Engineer, the Contractor's Start-Up/Quality Assurance Manager, and the Equipment Manufacturer. A separate file shall be established for each system, organized by start-up phase (i.e., pre-operational, functional, operational, acceptance test phase), and will include sections for each item of equipment. These files shall include the following information and documentation as a minimum. Test plan and documentation organization shall be as follows:

D. Test Plan Organization

1. Index.
2. Schedule
3. Step 1 & 2: Each type of equipment will have its own section within the system and include the following:
 - a. The detailed pre-operational test procedures.
 - b. The detailed functional test procedures.
 - c. Customized mechanical equipment, customized electrical, and customized instrumentation pre-operational and functional test forms as applicable.
 - d. Other pre-operational test documentation as required for piping and mechanical equipment.
4. Step 3: A separate section will be created for the system operational testing and include the following:
 - a. The detailed 5 day operational test procedure.
 - b. A detailed operational system check/sign-off sheet (based on system tests, control checks, and interlock checks to be performed).
 - c. System operational test completion sign-off form.
5. Step 4: Another section is to be designated for the Acceptance Testing and include the following:
 - a. Detailed work plans, communications plan, safety plan, and contingencies, as well as other requirements outlined under tie-ins and modifications to existing systems (SC-24).

- b. 30-day test overview and proposed spreadsheet forms to be utilized by the Contractors staff to record appropriate operational and performance data on a regular interval for the 30 days.
 - c. System acceptance test completion/sign-off form.
- 6. The forms attached to this Appendix are samples showing the required format and level of detail for documentation. The Contractor is advised that these are samples only and are not specific to this project nor to any item of equipment or system to be installed under this contract. The Contractor shall develop test documentation forms specific to each item of equipment and system installed under this contract. Acceptable example documentation forms for all systems and items of equipment shall be produced and submitted for review and approval by the City Engineer [as a condition precedent to the Contractor's receipt of progress payments in excess of 60 percent of the contract amount]. Once the City Engineer has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor shall produce customized forms for each item of equipment and system and include these individual forms in the overall test plan that will be submitted for approval.
- 7. The complete test plan and all its sections are to be submitted (60 days prior to any testing) and approved, Code 1 or Code 1C, prior to the start of any testing.

3.2 TEST PLAN IMPLEMENTATION

This program will be implemented in 4 distinct steps (phases). These steps are the Pre-Operational Checkout, the Functional Testing, the Operational Testing, and the Acceptance Testing.

3.3 STEP 1 - PRE-OPERATIONAL CHECKOUT AND TESTING

- A. The first step involves the Pre-operational checkout. This would include multi-discipline work completion and physical checkout .The Pre-operational Completion Verification and Pre-operational test reports include the following required testing. Examples of these documented tests include, but are not limited to:
 - 1. Field pressure/leakage test reports for all pipe, valves, and appurtenances.
 - 2. Wire insulation megohm reports for all 120V and greater wire.
 - 3. Phasing, ratio, polarity, ground resistance, current injection, insulation resistance, over potential test, and circuit breaker contact resistance reports for medium voltage switchgear.
 - 4. Insulation power factor and resistance test reports for surge arresters.

5. Megger reports for Unit Substations, Three Winding Transformers, and 4160V motor control centers.
6. Megger reports and ground connection tests.
7. Loop Status Report and Component Calibration forms.
8. Equipment installation checkout forms.

B. Pipe Testing

1. Prior to application of insulation on exposed piping, test the piping systems at the appropriate pressure according to the requirements of related piping specifications. All buried piping shall be tested prior to any backfill being placed, unless prior approval by the City Engineer is given in writing. Test duration shall be one-hundred twenty (120) minutes for all tests and witnessed by a City Engineer. Isolate equipment that may be damaged by the specified test conditions. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Testing shall include existing piping systems that connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping that fails the test shall be repaired.
2. For gas, air, and vapor systems, the allowable leakage rate for systems tested with air shall be based on a maximum pressure drop of 5 percent of the specified test pressure for the duration of the period. Prior to starting a test interval using air, the air shall be at ambient temperature and specified test pressure. The allowable leakage rate for hazardous gas systems, insulated systems, and systems tested with water shall be zero at the specified test pressure throughout the specified test period. Hazardous gas systems shall include sulfur dioxide, chlorine, propane, sludge gas and natural gas systems. Testing medium shall be as follows for gas, air, and vapor systems:

Pipeline size	Specified test pressure	Testing medium
2 inch and smaller	75 psi or less	Air or water
2 inch and smaller	Greater than 75 psi	Water
Greater than 2 inch	3 psi or less	Air or water
Greater than 2 inch	Greater than 3 psi	Water

3. For liquid systems, leakage shall be zero at the specified test pressure throughout the specified duration for exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals. Leakage from other buried liquid piping systems shall be less than 0.02 gallon per hour per inch diameter per 100 feet of buried piping. Drain systems, other than pumped drain systems, shall be tested in accordance with Georgia State Minimum Standards.
4. For hydraulic and lube oil systems, upon completion of cleaning, all field connections shall be completed and the system tested at the specified pressure. Pressure loss shall be zero for the specified test period. For fluid power systems, the manufacturer shall supervise the installation and testing of all system components including all field piping.

C. Pipe System Cleaning and Flushing

1. Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating or instrumentation equipment. The Contractor may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24 inches in diameter may be cleaned manually or with a cleaning ball or swab.
2. Upon completion of the cleaning, the Contractor shall connect the piping systems to related process equipment. Temporary screens, provided with locator tabs that remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

Equipment suction or piping size, inches	Maximum screen opening, inches
0 to 1	1/16
1-1/4 to 3	1/4
3-1/2 to 6	1/2
Over 6	1

3. The Contractor shall maintain the screens during all testing prior to the start of Acceptance testing. In special cases, screens may be removed as required for performance tests. Prior to the start of Acceptance Testing, the Contractor shall remove the temporary screens and make the final piping connections after the screens

have remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempted.

4. Gas and air system piping 6 inches in diameter and smaller shall be blown out, using air or the testing medium specified. Piping larger than 6 inches shall be cleaned by having a swab or "pig" drawn through the separate reaches of pipe. After connection to the equipment, it shall then be blown out using the equipment. Upon completion of cleaning, the piping shall be drained and dried with an air stream. Sludge gas, natural gas and propane systems shall be purged with nitrogen and a nitrogen pad maintained at 10 psig until the piping is placed in service.
5. After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens. Potable water piping systems shall be flushed and disinfected in accordance with AWWA C651.
6. Upon completion of all field piping, but before connection to any control components, hydraulic and fluid power oil systems shall be flushed and cleaned by circulating special flushing oil through the system. Flushing oil and procedures shall comply with ASTM D4174. System shall be cleaned such that internal contamination of system, when tested using procedures specified in SAE J1227, Section 2.3, shall not exceed the Allowable Cleanliness Level (ACL). Unless otherwise specified, the ACL value shall be established by the manufacturer of the major hydraulic system components in accordance with SAE J1227, Section 9.1. System supplier shall provide certificate of compliance that the ACL has been met.

D. Equipment – Pre-Operational Checkout

Equipment pre-operational checks and tests shall include, but are not limited to, the following:

1. Check for proper installation, alignment, support, and anchorage per the applicable manufacturers operation and maintenance manual and in accordance with the contract documents.
2. Check the equipment for proper adjustment, packing of seals, lubrication, drive connection, motor connection, and belt/chain tension per the applicable manufacturers operation and maintenance manual and in accordance with the contract documents.
3. Check the associated process, seal water, drain, and vent pipe connections for proper routing and connection. Check to insure the pipe testing was performed and signed as completed for all the associated piping.

4. Insure that the equipment is clean and free of any construction debris that could potentially cause a malfunction.
5. Insure that all safety guards, signage, and other safety measures such as hearing protection, etc., are in place.
6. Have the manufacturer's representative perform all pre-operational tests per the manufacturers' recommendations and review the equipment installation and sign the Manufacturer's Installation portion of the certification form. If the manufacturer's representative brings his own checklist, obtain a copy of the completed form and attach it to the Contractors completed forms. Note that the manufacturer must also fill out the contract approved checkout form (their own form will not serve as a substitute).
7. All gates and valves associated with the equipment system must be checked for proper installation, adjustment, and lubrication per the manufacturer's recommendations.

E. Concrete Tanks – Pre-Operational Checkout

All water-retaining concrete structures shall be tested for watertightness in accordance with ACI 350.1R. The maximum allowable leakage rate shall be 0.075% over a 24 hour period.

F. Electrical Pre-Operational Checks/Tests

Prior to energizing electrical circuits, use a 1,000-volt megohmmeter to measure insulation resistance on conductors and insulated parts of electrical equipment. All measurements shall meet or exceed the appropriate ICEA, NEMA, or ANSI standard. Any insulation resistance less than 10 megohms is unacceptable. Record results, as well as ambient temperature. See attached form for example.

1. Measure phase-to-ground insulation resistance for all circuits 120 volts and above, with the exception of lighting circuits. Measurements may be made with motors and other equipment connected, except that solid state equipment shall be disconnected unless the equipment is normally tested by the manufacturer at voltages in excess of 1000 volts DC.
2. Complete Test Form for each installed motor. Measure the insulation resistance of all motors before connection. Measure the insulation resistance for all motors at the time of delivery as well as when connected. Insulation resistance values less than 10 megohms are not acceptable.
3. Adjust and make operative all protective devices. Perform a functional check of the control circuit prior to energization of the equipment.
4. Review all associated electrical terminations, switches, and breakers for satisfactory installation.

G. G. Individual Component/Instrument Calibration Pre-Operational Check/Test

1. Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure. Instruments shall then be tested in compliance with ISA S51.1 and the data entered on the applicable test report form. Alarm trips, control trips, and switches shall be set to initial values specified in the design at this time. Final elements shall be checked for range, dead band, and speed of response.
2. Calibration of analysis instruments, sensors, gauges, and meters installed under this contract shall proceed on a system-by-system basis. No equipment or system operational, performance or acceptance tests shall be performed until instruments, gages, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the City's Engineer.
3. Testing of instrument process piping/tubing, wiring and individual components shall be completed and documented on the approved test forms provided to the City Engineer as part of the pre-operational testing phase and prior to commencement of individual loop testing conducted during the pre-operational functional test phase.
4. Any component which fails to meet the required tolerances shall be repaired by the manufacturer or replaced, and the above tests repeated until the component is within tolerance.
5. System instrumentation equipment supplied and installed must also be reviewed for proper installation and termination as part of the pre-operational checkout.

H. Pre-Operational Checkout Summary

1. The pre-operational checkout and testing for each item shall be carried out in accordance with the Contractors submitted and approved procedures and documented on the Contractors approved pre-operational test forms.
2. The Contractor shall complete the pre-operational testing requirements listed above, at a minimum, for each item of mechanical, electrical, instrumentation, and HVAC equipment prior to beginning any functional testing with regard to the equipment or the systems in which the equipment functions.

3.4 STEP 2 - FUNCTIONAL TEST

A. General

1. The second step in the program is the Functional Test. This is the functional testing of the equipment. These tests begin for each item of equipment only after the Pre-operational Checks have been completed for all components for the particular equipment.

2. The functional testing for each item of equipment shall be carried out in accordance with the Contractors submitted and approved procedures and documented on the Contractors approved functional test forms.
3. Once 1) all affected equipment has been subjected to the required pre-operational testing procedures; and 2) the City Engineer has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the Contract Standards. If available, plant process media may be employed for the testing of all liquid systems except gaseous, oil, or chemical systems. If not available, potable water shall be employed as the test medium. Test media for these systems shall either be the intended fluid or a compatible substitute. The equipment shall be operated for a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, the Contractor shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system at no additional cost to the City. Disposal methods for test media shall be subject to review by the City Engineer. During the functional test period, the Contractor shall obtain baseline operating data on all equipment with motors greater than 1 horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for use in the CMMS.
4. Test results shall be within the tolerances set forth in the detailed specification sections of the Contract Documents and as indicated in the Contractors functional test plan and the manufacturers criteria. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory functional test, any doubt, dispute, or difference should arise between the City Engineer and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the City Engineer may order the test to be repeated at the Contractors expense. Where the results of any functional test fail to comply with the Contract Standards for such test, then such repeat tests as may be necessary to achieve the Contract Standards shall be made by the Contractor at his expense.

- B. The Functional Test reports (test documentation) include the required testing. Examples of these types of reports include, but are not limited to:

1. The Functional Field Test of valves.
 2. The cycling/functions check of the sluice gates, slide gates, weir gates, stop logs, and stop plates.
 3. The leakage testing of sluice gates, slide gates, weir gates, stop logs, and stop plates in accordance with AWWA specifications.
 4. Vibration, noise, and capacity testing of Pumps.
 5. Air distribution and leakage test of any diffused air systems.
 6. Loop functional test for Instrumentation and Control.
- C. Process/Mechanical/Equipment – (Functional Testing)
1. During the Functional Verification Check and Testing process, the Contractor and the various Manufacturers' Technical representatives shall examine and record the initial start-up performance of the components provided by their respective firms in accordance with the Contractors approved functional test procedure.
 2. The initial operation, testing and adjustment shall be as required to prove that the equipment has been installed properly and operates under the conditions specified.
 3. Upon completion of this work, the manufacturer's field service technician shall complete the Contractors approved functional test form as well as their own signed report to record the results of his/her inspection, operation, adjustments and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results if such are specified, and suggestions for precautions to be taken to ensure proper maintenance.
- D. Electrical - (Functional Testing)
1. The Contractors' electrician shall be present during all testing to confirm the electrical, provide troubleshooting assistance, repair as needed, and assist in gathering baseline data such as motor amperages.
 2. Energize each control circuit and operate each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. The Contractor shall submit a description of his proposed functional electrical test procedures as part of the testing plan.
 3. Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation.
- E. Instrumentation and Control – (Functional Testing)
1. The Contractors' instrumentation representative shall be on site full time during the functional test phase to perform loop checks and to support the Contractors start-up team as needed. Any

packaged equipment or manufacturer supplied control panels must be field tested to verify all control interlocks and control functions during this phase of testing by the equipment supplier. Note that the Contractors functional test procedure for each piece of equipment shall define each interlock to be tested.

2. Each instrument loop shall be tested. This testing shall check operation from transmitter to readout components. Signals shall be generated utilizing the primary measuring elements where possible. Signals shall be injected only if primary element is unavailable.
3. If any output device fails to indicate properly, corrections to the loop shall be made as necessary and the test repeated until all instruments operate properly.

F. Functional Testing Summary

The functional testing for each item of equipment, electrical, and instrumentation shall be carried out in accordance with the Contractors submitted and approved procedures and documented on the Contractors approved functional test forms.

3.5 STEP 3 – OPERATIONAL TESTING

- A. The third step in the program is the Operational Testing. This step begins after all Pre-operational checks and Functional tests have been satisfactorily completed. The Contractor shall plan his activities to allow for City witnessing of all tests and shall provide twenty-four (24) hours advance notice of all testing activities.
- B. The Contractors operational test plan shall be a detailed procedure to confirm all System Automatic Mode functions, verify all system interlocks, and reconfirm all equipment functions and controls. All design and performance criteria will be demonstrated and documented during this 5 day period. The Contractors manufacturer, electrical, and instrumentation representatives will be on site on an 8 hour a day basis and locally on a 24 hours a day basis during this period.
- C. In the event of failure to demonstrate satisfactory performance of the system on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the system is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the system has operated continuously to the satisfaction of the Owner and Engineer, for the specified duration.

3.6 STEP 4 – ACCEPTANCE TESTING

- A. The fourth step in the program is Acceptance Testing. The acceptance test period shall not begin until all new systems and equipment have successfully completed the operational test period.
- B. The Operations and Maintenance staff shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup with plant process media. All valve tagging shall also be complete prior to this startup.
- C. As part of the acceptance test plan the Contractor shall submit detailed work plans, communications plan, safety plan, contingencies, and other requirements as outlined under tie-ins and modifications to existing systems (SC-24). Also a 30 day test overview and proposed spreadsheet forms to be utilized by the Contractors operations staff to record appropriate operational and performance data on a regular interval for the 30 days.
- D. Prerequisites
 1. Prior to the City's issuance of a Certificate of Substantial Completion for all Improvements, the contractor shall perform Acceptance Testing. Acceptance Testing and the Acceptance Test Plan shall comprehensively cover all potential modes of operation, including failure scenarios, as well as the operation of ancillary systems, to demonstrate full functionality of the Improved Facilities. Any failures of process, equipment or systems shall result in re-starting the acceptance testing period. The testing period shall be a minimum of 30 days of continuous operation, during which the facility must meet the following criteria:
 2. Continuous satisfactory operation at the rated capacity;
 3. Operation without violating the Contract Standards;
 4. Operation without creating a materially unsafe condition, nuisance condition or unacceptable risk to personnel, facilities or the public;
 5. Operation without producing Biosolids products, air or water emissions, traffic, noise, odors, or other environmental impacts that the City, in its sole discretion, determines to be unacceptable to public safety, health or welfare.
 6. All portions of the acceptance test phase will be carried out by qualified/certified operations personnel (supplied by the Contractor) that have a thorough knowledge of the process and can fully implement and document the facility performance as well as the Contractors acceptance test plan.
- E. Instrumentation Acceptance Test

1. The instrument loop acceptance test shall fully demonstrate stable operation of the loop under normal operating conditions. This test shall be witnessed by a City Engineer and performed and documented by the Instrumentation System Supplier.
2. Tuning parameters (proportional gain, integral time constant, and derivative time constant) for each control loop shall be adjusted to provide 1/4 amplitude damping unless otherwise specified and witnessed during system supplier factory testing.

F. Flow Meters

Liquid flow meters, including all open channel flow meters and all meters installed in pipelines with diameters greater than 2 inches shall be calibrated in-situ using either the total count or dye dilution methods. Gas flow meters installed in piping systems with diameters greater than 6 inches shall be calibrated in-situ using the pitot tube velocity averaging method. Flow meter calibration work shall be performed by individuals skilled in the techniques to be employed. Calibration tests for flow metering systems shall be performed over a range of not less than 10 percent to at least 75 percent of system full scale. At least five confirmed valid data points shall be obtained within this range and witnessed by a City Engineer. Confirmed data points shall be validated by not less than three test runs with results which agree within plus or minus 2 percent.

- G. In the event of failure to demonstrate satisfactory performance of the system on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the system is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the system has operated continuously to the satisfaction of the Owner and Engineer, for the specified duration.
- H. All completed operational test forms will be placed into the master record test plan binder and provided to the City of Atlanta prior to acceptance.

+++ END OF SECTION 01650 +++

SECTION 01664

TRAINING

PART 1 - GENERAL

1.1 DESCRIPTION

This section contains requirements for training the City's personnel, by persons retained by the CONTRACTOR specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this Contract.

1.2 QUALITY ASSURANCE

Where required by the detailed specifications, the CONTRACTOR shall provide on-the-job training of the City's personnel. The training sessions shall be conducted by qualified, experienced, factory-trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

1.3 SUBMITTALS

The following information shall be submitted to the City's Engineer in accordance with paragraph GC-31 of the GENERAL CONDITIONS. The material shall be reviewed and accepted by the City's Engineer as a condition precedent to receiving progress payments in excess of 75 percent of the Contract amount and not less than 3 weeks prior to the commencement of training.

- A. Preliminary Training Plan: Submit within 120 days after Notice to Proceed.
- B. Training Schedule: Submit not less than 30 days prior to start of equipment installation and revise as necessary for acceptance.
- C. Final Training Plan: Submit after training coordination meeting.
- D. Lesson plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.
- E. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

PART 2 - PRODUCTS

2.1 GENERAL

Where specified, the CONTRACTOR shall conduct training sessions for the City's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work after the equipment has been installed and tested and under the conditions specified in the following paragraphs. Approved operation and maintenance manuals shall be available at least 30 days prior to the date scheduled for the individual training session.

2.2 TRAINING PLAN

- A. Preliminary Training Plan: If specified, and within 120 days after Notice of Award, submit for each proposed course:
 - 1. Title and objectives.
 - 2. Training schedule.
 - 3. Prerequisite training and experience of attendees.
 - 4. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).
 - 5. Course description and outline of course content.
 - 6. Duration.
 - 7. Location (e.g., training center or site).
 - 8. Format (e.g., lecture, self-study, demonstration, hands-on).
 - 9. Instruction materials and equipment requirements.
- B. Final Training Plan: Submit the following after training coordination meeting, if specified.
 - 1. Updated versions of course descriptions from preliminary training plan.
 - 2. Who will attend each course.
 - 3. Schedule of training courses including dates, durations, and locations of each class.
 - 4. Detailed course schedule for each day showing time allocated to each topic.
 - 5. Resumes of instructors providing the training.

2.3 TRAINING SCHEDULE

- A. List specified equipment and systems with respective manufacturers that require training services of manufacturers' representatives and show:
 - 1. Estimated dates for installation completion.
 - 2. Estimated training dates to allow for multiple sessions when several shifts are involved.
- B. Adjust training schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by

manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.

- C. Coordinate with Progress Schedules as specified in Special Conditions and Section 01650, FACILITY STARTUP.

2.4 LOCATION

Training sessions shall take place at the site of the work.

2.5 LESSON PLANS

- A. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject.
- B. One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the City and shall be suitably bound for proper organization and easy reproduction. The CONTRACTOR shall furnish ten copies of necessary training manuals, handouts, visual aids and reference materials at least 1 week prior to each training session.

2.6 FORMAT AND CONTENT

Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

- A. Familiarization:
 - 1. Review catalog, parts lists, drawings, etc., which have been previously provided for the plant files and operation and maintenance manuals.
 - 2. Check out the installation of the specific equipment items.
 - 3. Demonstrate the installed unit and indicate how all parts of the specifications are met.
 - 4. Answer questions.
- B. Safety:
 - 1. Using material previously provided and installed equipment, review safety references.
 - 2. Discuss proper precautions around equipment.
- C. Operation:
 - 1. Using material previously provided and installed equipment, review reference literature.

2. Explain all modes of operation (including emergency).
 3. Check out City's personnel on proper use of the equipment.
- D. Preventive Maintenance:
Using material previously provided and installed equipment, review preventive maintenance (PM) lists including:
1. Reference material.
 2. Daily, weekly, monthly, quarterly, semi-annual, and annual jobs.
 3. Show how to perform PM jobs.
 4. Show City's personnel what to look for as indicators of equipment problems.
- E. Corrective Maintenance:
1. List possible problems.
 2. Discuss repairs; point out special problems.
 3. Open up installed equipment and demonstrate procedures, where practical.
- F. Parts:
1. Show how to use previously provided parts list and order parts.
 2. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.
- G. Local Representatives:
1. Where to Order Parts: Name, address, and telephone.
 2. Service Problems:
 - a. Who to call.
 - b. How to get emergency help.
- H. Operation and Maintenance Manuals:
1. Review any other material submitted.
 2. Update material, as required.

2.7 VIDEO RECORDING

The City will retain the services of a commercial videotaping service to record each training session. After taping, the material may be edited and supplemented by the City with professionally produced graphics to provide a permanent record. The CONTRACTOR shall advise all manufacturers providing training sessions that the material will be videotaped and shall make available to the City's videotaping CONTRACTOR such utility services and accommodation as may be required to facilitate the production of the video tape record.

PART 3 - EXECUTION

3.1 GENERAL

- A. Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The CONTRACTOR shall arrange to have the training conducted on consecutive days, with no more than 6 hours of classes scheduled for any one day. Concurrent classes shall not be allowed. Contractor/Manufacturer is to plan for up to three classes in any 24 hour period to ensure all shifts are properly trained
- B. Acceptable operation and maintenance manuals for the specific equipment shall be provided to the City prior to the start of any training. Videotaping shall take place concurrently with all training sessions.
- C. The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.
 - 1. As a minimum classroom equipment training for operations personnel will include:
 - a. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.
 - b. Purpose and plant function of the equipment.
 - c. A working knowledge of the operating theory of the equipment.
 - d. Startup, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.
 - e. Identify and discuss safety items and procedures.
 - f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
 - g. Operator detection, without test instruments, of specific equipment trouble symptoms.
 - h. Required equipment exercise procedures and intervals.
 - i. Routine disassembly and assembly of equipment if applicable (as judged by the City on a case-by-case basis) for purposes such as operator inspection of equipment.
 - 2. As a minimum, hands-on equipment training for operations personnel will include:
 - a. Identify location of equipment and review the purpose.
 - b. Identifying piping and flow options.
 - c. Identifying valves and their purpose.
 - d. Identifying instrumentation:
 - 1) Location of primary element.
 - 2) Location of instrument readout.

- 3) Discuss purpose, basic operation, and information interpretation.
 3. Discuss, demonstrate, and perform standard operating procedures and routine checks.
 4. Discuss and perform the preventative maintenance activities.
 5. Discuss and perform startup and shutdown procedures.
 6. Perform the required equipment exercise procedures.
 7. Perform routine disassembly and assembly of equipment if applicable.
 8. Identify and review safety items and perform safety procedures, if feasible.
- D. Classroom equipment training for the maintenance and repair personnel will include:
1. Theory of operation.
 2. Description and function of equipment.
 3. Startup and shutdown procedures.
 4. Normal and major repair procedures.
 5. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
 6. Routine and long-term calibration procedures.
 7. Safety procedures.
 8. Preventative maintenance such as routine lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.
- E. Hands-on equipment training for maintenance and repair personnel shall include:
1. Locate and identify equipment components.
 2. Review the equipment function and theory of operation.
 3. Review normal repair procedures.
 4. Perform startup and shutdown procedures.
 5. Review and perform the safety procedures.
 6. Perform City approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

+++ END OF SECTION +++

SECTION 01780

ASSET MANAGEMENT RECORDS

PART 1 - GENERAL

1.1 SCOPE

The work under this Section includes gathering and electronically recording financial and technical information needed to support the Owner's Fixed Asset Registry and Computerized Maintenance Management System (CMMS).

1.2 FIXED ASSETS

- A. The Contractor shall generate the financial information necessary to support the Owner's Fixed Asset Registry, CMMS and submit the information periodically, as directed by the Engineer.
- B. Financial information (Purchase/Salvage/Disposal Price) shall be provided for the following categories of assets:
 - 1. Equipment - All equipment with a purchase value of \$5,000 or more and all equipment that has been assigned an "equipment" or "tag" number in contract documents. The term "equipment" includes but is not limited to: all process equipment, HVAC equipment, instrumentation, valves and gates (including actuators), tanks, electrical panels (including switchgear, MCCs, VFDs, panel boards, automatic transfer switches, heat trace panels, and the like), factory and field control panels, patch panels, control system panels (including PLC and DCS cabinets, marshalling (I/O) cabinets, etc.), roll-up doors, cranes and hoists, copiers, maintenance equipment, shelving, cabinets, laboratory equipment, furniture and A/V equipment. The asset value of the equipment shall be the Contractor's actual purchase price without installation, taxes, overheads, or mark-ups. The Contractor shall obtain a breakdown of equipment values from its vendors and suppliers, where possible, and use its best efforts to provide or estimate the actual purchase price. In addition, the Contractor shall provide an estimate of the cost of installation of each equipment item (e.g., setting, aligning, grouting, etc.)
 - 2. Structure – The cost of structures (typically those structures that require individual building permits) including all labor associated with the structure and all materials (including piping, raceway, wiring, supports, and appurtenances) incorporated into the structure. The structure cost shall include all improvements to the structure and, as applicable, the cost of demolition or other changes to the structure, as directed by the Engineer.

3. Site Improvements – The cost of site improvements shall include all earthwork, manholes / handholes, culverts and drainage structures, piping, ductbank and wiring not incorporated in a structure, roads, curbs, sidewalks, grassing and landscaping, demolition, and any other improvements to the site. The site improvements cost shall include all improvements to the site and, as applicable, the cost of demolition or other changes to the site, as directed by the Engineer.
 4. Special Items – Certain portions of the construction may have a different useful life (from an accounting standpoint). An example of this is roofing on a structure. These special items, as directed by the Engineer, shall be listed separately. The Contractor shall also provide an estimate of the installation cost of the special item.
 5. General Costs - The Contractor shall provide, as a separate line item when directed by the Engineer, the contractor's general costs (general conditions, field engineering, management, supervision, overhead, profit, mobilization, demobilization, permits, bonds, insurance, etc.), associated with the Project.
 6. Salvage Items - The Contractor shall provide, as a separate line item when directed by the Engineer, description of items removed from service and returned to the City as Salvage associated with the Project.
 7. Disposed Items - The Contractor shall provide, as a separate line item when directed by the Engineer, description of items removed from service and disposed associated with the Project.
- C. The Contractor shall provide the required financial information in a format acceptable to the Engineer, with the cost information displayed individually, distributed, or rolled up as directed by the Engineer. See Part 1.6 for examples.
- D. Information to be included as part of fixed asset reporting shall include, as applicable:
1. Tag Number (equipment number, structure number, other unique identification number, as applicable, and as directed by the Engineer)
 2. Structure Name (for site improvements use "Site Improvements")
 3. Description (equipment description or description of asset)
 4. Manufacturer
 5. Vendor (or supplier)
 6. Model Number
 7. Serial Number
 8. Purchase Price (cost as defined above, if applicable)
 9. Installed Date (usually the date of Substantial Completion) or Date removed from service
 10. Extended Warranty Information (if applicable)

1.3 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM:

- A. In addition to the Fixed Asset information described above, the Contractor shall collect information needed to support data input for the Owner's Computerized Maintenance Management System (CMMS) and submit the information periodically, as directed by the Engineer. Both the Fixed Asset and CMMS data information will be submitted monthly as a requirement of the payment application process.
- B. The Contractor will collect equipment information on all installed equipment that has an associated preventative maintenance in the vendor's O&M manuals.
- C. The Contractor shall take digital photos of all equipment nameplates and electronically file the information by Structure Name and Tag Number. Data (such as serial numbers) must be collected or verified from equipment after it is in its installed location.
- D. A substantial part of the data needed for the CMMS is provided on the equipment nameplates, however, the Contractor may need to refer to submittals, operations and maintenance manuals, and/or other manufacturer information to obtain dimensions, weights, etc., that are not included on nameplates.
- E. Part 1.5 below provides examples of information needed for various types of equipment. Multiple forms may be needed for a single piece of equipment. Actual information required will be as directed by the Engineer.

1.4 INFORMATION SUBMITTALS

- A. The Contractor shall record in a Microsoft Excel spreadsheet file, the data collected for the Asset Registry and CMMS to the Owner through the Engineer.
- B. The format of a typical Asset – CMMS Spreadsheet is as shown in the first two exhibits under Part 1.6 with each asset on a separate row and the various data fields in columns (only the first nine columns of a 100+ column spreadsheet are shown). Due to the nature of instrumentation, a separate detailed Instrumentation Spreadsheet (which allows multiple model / serial numbers and other unique information to be associated with a single instrument) is also shown in the third exhibit under Part 1.6. The total cost for instrumentation from the Instrumentation Spreadsheet, in the example, is entered as a line item in the Asset – CMMS Spreadsheet.
- C. A separate Asset – CMMS Spreadsheet shall be prepared for each structure or portion of the Project, including site improvements, as directed by the Engineer.

- D. A database with a single table and forms similar to those shown in Part 1.05 is a suggested means for data entry, with such database table exported to an MS Excel spreadsheet to produce the required spreadsheet for each structure or portion of the Project. The creation of the database is not required.
- E. To the extent available, the Contractor should obtain a list(s) of equipment as described in Part 1.2 Paragraph B.1 above from the Engineer for importation into the database or spreadsheet(s).
- F. The Contractor shall submit to the Engineer, a draft of the Asset – CMMS Spreadsheet for each structure or portion of the Project, by the 50% construction complete stage of the structure or portion of the Project, for review as to form and completeness of the asset list. If requested by the Engineer, the Contractor shall submit copies of the spreadsheet periodically (but no more than once a month), as a work in progress for the Engineer’s review. Failure to submit the spreadsheets, as requested by the Engineer, may result in delayed processing of the most current pay request (until the spreadsheet is submitted and accepted).
- G. After an O&M has been accepted with no exceptions taken, the preventative maintenance detailed in the O&M manual shall be entered in an Excel spreadsheet for importation into the City’s CMMS. The Contractor will submit copies of the spreadsheet as part of the CMMS Spreadsheet submittal as a work in progress for the Engineer’s review. Failure to submit the spreadsheets, as requested by the Engineer, may result in delayed processing of the most current pay request (until the spreadsheet is submitted and accepted).
- H. The Contractor shall submit, to the Engineer, a preliminary copy of the Asset - CMMS Spreadsheet for any structure or portion of the Project a minimum of sixty (60) days prior to the anticipated Substantial Completion date for that structure or portion of the Project, with all information complete, except for the date of Substantial Completion. The final Asset - CMMS Spreadsheet for each structure or portion of the Project shall be submitted as part of the requirement for Substantial Completion. Failure to submit the spreadsheet as described above may result in delay in achieving Substantial Completion.
- I. At the end of the Project, all Asset -CMMS Spreadsheets pertaining to the work must be complete, submitted to and accepted by the Engineer in order to achieve Final Completion of the Project. The total of all spreadsheets for the Project must equal the total Contract Price.

1.5 EXAMPLES OF TYPICAL DATA AND SUGGESTED DATABASE TABLES

The 'General : Form' window displays a 'General' data entry form. It includes a 'Search' dropdown menu, a 'TAG_NO' text field, a 'StructureTitle' text field, and an 'Equipment Description' text field. Below these are several pairs of text fields: 'Manufacturer' and 'InstalledDate', 'Vendor' and 'WarrantyExpdate', 'MODEL' and 'PurchasePrice' (pre-filled with '\$0.00'), and 'SerialNumber' and 'ProRateExtendWarranty'. At the bottom, a record navigation bar shows 'Record: 1 of 952' with standard navigation icons.

The 'Motor Data 1 : Form' window displays a 'Motor Data' data entry form. It includes a 'Search' dropdown menu, a 'TAG_NO' text field, and an 'EquipmentDescription' text field. Below these are several pairs of text fields: 'MotorManufacturer' and 'MotorEnclosure', 'MotorModel' and 'MotorFrame', 'MotorSerial' and 'MotorType', 'MotorHorsepower' and 'EVOLT', 'MotorSpeed' and 'E_PHASE', 'MotorServiceFactor' and 'MotorAmps', 'MotorInsulation' and 'MotorDesignTemp', and 'MotorNoiseLevel' and 'MotorDriveType'. A 'MotorWeight' text field is located at the bottom. At the bottom, a record navigation bar shows 'Record: 1 of 952' with standard navigation icons.

Gearbox Data 1 : Form

#Name?

Gearbox Data

Search

TAG_NO:

EquipmentDescription:

GearReducerManuf: GearReducerType:

GearModel: GearReducerRatio:

GearSerial: GearHP:

GearWeight: GearTorque:

GearSpeed:

Record: of 952

Actuator Data : Form

#Name?

Actuator Data

Search

TAG_NO:

EquipmentDescription:

ActuatorManuf: ActuatorBase:

ActuatorModel: ActuatorCoupling:

ActuatorSize:

ActuatorSerialNo: ActuatorSpeed:

ActuatorTempCode: ActuatorTorque:

NEMAEnclosure: Lubrication:

ActuatorMotorRating: ActuatorElectClass:

E_VOLT: E_AMPS:

E_PHASE:

ActuatorWeight:

Record: of 952

Tank Data : Form

Storage Tank Data

#Name?

Search

TAG_NO:

EquipmentDescription:

Diameter: BaseElevation:

E_CAPACITY: ConstructionMatl:

Length: CheckValveSize:

Width: CheckValveType:

Height:

Record: of 952

Electrical Equip Data : Form

Electrical Equipment Data

#Name?

Search

TAG_NO:

EquipmentDescription:

EVOLT: Type:

E_PHASE: E_AMPs:

Source: NEMAEnclosure:

Record: of 952

Pump Data : Form

Pump Data #Name?

Search

TAG_NO:

Equipment Description:

Type: TDH:

ConstructionMaterial: GPM:

Service: MGD:

Weight: RatedPressure:

Centrifugal Pumps **Hose Pumps**

ImpellerSize: Hose/InsertType:

SuctionLineSize: Hose/TubeSize:

DischargeLineSize: CapacityPerRevolution:

BodyStyle:

CastAndRotor:

Submersible Pump Electrical Info

E_VOLT: E_HP:

E_PHASE: E_RPM:

Record: of 952

Other Equipment Data : Form

#Name?

Other Equipment Data

Search

TAG_NO:

EquipmentDescription:

Type: E_Weight:

E_CAPACITY:

Gates and Valves **Conveyors**

Width: ScrewDiameter:

Height: ScrewLength:

ValveSize: FlightSize:

Actuator? Fans / Blowers

GearBox? E_Speed:

ConstructionMatl:

Related Equipment Data

E1Type: E2Type:

E1Manufacturer: E2Manufacturer:

E1ModelNo: E2ModelNo:

E1SerialNo: E2SerialNo:

Record: 1 of 952

1.6 ASSET REGISTRY CMMS SPREADSHEET EXAMPLES

Microsoft Excel - Databasexls100706-FSL									
File Edit View Insert Format Tools Data Window Help									
Type a question for help									
F109									
A	B	C	D	E	F	G	H	I	
1	TAG_NO	StructureTitle	EquipmentDescription	Manufacturer	Vendor	MODEL	SerialNumber	PurchasePrice	InstalledDate
2	06	06 - FINE SCREENING - LIME	FSL Structure	Pizzagalli	Pizzagalli	N/A	N/A	\$6,300,000	5/25/2010
3	06inst	06 - FINE SCREENING - LIME	Instrumentation (see Invensys details)	Various	Invensys	N/A	N/A	\$62,200	5/25/2010
4	06roof1	06 - FINE SCREENING - LIME	Standing Seam Roof	Berrage	Pierre	N/A	N/A	\$85,000	5/25/2010
5	06roof2	06 - FINE SCREENING - LIME	Built-up Roof	Johns - Mansville	Dakota	N/A	N/A	\$40,000	5/25/2010
6	ACC-0601	06 - FINE SCREENING - LIME	Air Cooled Condenser	Liebert	Shumate	PFH067AH	N/A	\$50,000	5/25/2010
7	AHU-0601	06 - FINE SCREENING - LIME	DX Air Handling Unit	Liebert	Shumate	BU060E	N/A	\$75,000	5/25/2010
8	ATS-0601	06 - FINE SCREENING - LIME	Automatic Transfer Switch	Eaton	Mayer	ATV3KDA30300XJU	LAT04380-002	\$2,405	5/25/2010
9	Door-06-101B	06 - FINE SCREENING - LIME	Fine Screen Roll-up Door	APD	APD	Pro GHX	193718	\$10,000	5/25/2010
10	Door-06-102B	06 - FINE SCREENING - LIME	Lime Roll-up Door	APD	APD	Pro GH4X	193715	\$10,000	5/25/2010
11	EUH-0601	06 - FINE SCREENING - LIME	Electric Unit Heater	TPI Corporation	Shumate	P3P5505T 43wD5T01	N/A	\$2,000	5/25/2010
12	EUH-0602	06 - FINE SCREENING - LIME	Electric Unit Heater	TPI Corporation	Shumate	P3P5505T 43wD5T01	N/A	\$2,000	5/25/2010
13	F-0601	06 - FINE SCREENING - LIME	FRP axial supply fan	Hartzell	Shumate	A35-366-E-FGF-M3	0921759	\$10,000	5/25/2010
14	F-0602	06 - FINE SCREENING - LIME	Propeller Wall exhaust Fan	Loren Cook	Shumate	240AW-24AB	0505C58531-00/0000701	\$5,000	5/25/2010
15	F-0603	06 - FINE SCREENING - LIME	Propeller Wall exhaust Fan	Loren Cook	Shumate	AwB-24A6B	0505C58531-00/0002101	\$5,000	5/25/2010
16	F-0604	06 - FINE SCREENING - LIME	Propeller wall exhaust fan	Loren Cook	Shumate	160AW-16A17D	0505L58531-00/0003501	\$5,000	5/25/2010
17	F-0605	06 - FINE SCREENING - LIME	Propeller wall exhaust fan	Loren Cook	Shumate	AwD-20A11DA	0505L58531-00/0004801	\$5,000	5/25/2010
18	FCP-06C11	06 - FINE SCREENING - LIME	Silo No. 1 Truck Fill Panel	RDP Technologies	TDH Company	0803	N/A	\$10,000	5/25/2010
19	FCP-06C12	06 - FINE SCREENING - LIME	Lime System No. 1 FCP	RDP Technologies	TDH Company	N/A	UL# 979572	\$10,000	5/25/2010
20	FCP-06D11	06 - FINE SCREENING - LIME	Silo No. 2 Truck Fill Panel	RDP Technologies	TDH Company	0803	N/A	\$10,000	5/25/2010
21	FCP-06D12	06 - FINE SCREENING - LIME	Lime System No. 2 FCP	RDP Technologies	TDH Company	N/A	UL# 979571	\$10,000	5/25/2010
22	FCP-06E31	06 - FINE SCREENING - LIME	Compressed air FCP	Quincy	Pizzagalli	N/A	5623	\$5,000	5/25/2010
23	FCP-06E51	06 - FINE SCREENING - LIME	Lime Unloading Blower FCP	Benshaw Controls	Aerzen	N/A	E20814175-3	\$5,000	5/25/2010
24	FV-06C24	06 - FINE SCREENING - LIME	Pebble Lime Flow Valve #1	Bray	RDP	30-119	03663468	\$2,000	5/25/2010
25	FV-06C29	06 - FINE SCREENING - LIME	Slaked Lime Flow Valve #1	Bray	RDP	30-119	03730145	\$2,000	5/25/2010
26	FV-06D24	06 - FINE SCREENING - LIME	Pebble Lime Flow Valve #2	Bray	RDP	30-119	03663469	\$2,000	5/25/2010
27	FV-06D29	06 - FINE SCREENING - LIME	Slaked Lime Flow Valve #2	Bray	RDP	30-119	03730140	\$2,000	5/25/2010
28	G-06A01	06 - FINE SCREENING - LIME	Fine Screen No. 1 Inlet Gate	Fontaine	Fontaine	2537272KCw/FE	2535070966221-1	\$20,000	5/25/2010
29	G-06A02	06 - FINE SCREENING - LIME	Fine Screen No. 2 Inlet Gate	Fontaine	Fontaine	2537272KCw/FE	2535070966221-2	\$20,000	5/25/2010
30	G-06A31	06 - FINE SCREENING - LIME	Fine Screen No. 1 Outlet Gate	Fontaine	Fontaine	2537299KCw/FE	2535070966231-1	\$20,000	5/25/2010
31	G-06A32	06 - FINE SCREENING - LIME	Fine Screen No. 2 Outlet Gate	Fontaine	Fontaine	2537299KCw/FE	2535070966231-2	\$20,000	5/25/2010
32	G-06A43	06 - FINE SCREENING - LIME	Fine Screen Inlet Box Gate	Fontaine	Fontaine	2035454KCw	2035070966211-1	\$20,000	5/25/2010
33	H-0601	06 - FINE SCREENING - LIME	480V Panelboard	Eaton	Mayer	PRL3A	LAT04380-022	\$787	5/25/2010
34	H-0602	06 - FINE SCREENING - LIME	480V Panelboard	Eaton	Mayer	PRL2A	LAT04380-019	\$578	5/25/2010
35	H-0603	06 - FINE SCREENING - LIME	480V Panelboard	Eaton	Mayer	PRL3A	LAT04380-020	\$578	5/25/2010
36	HTMP-0601	06 - FINE SCREENING - LIME	Heat Trace Monitoring Panel	Cleveland Electric Compar	Cleveland Electric Compar	N/A	N/A	\$1,000	5/25/2010
37	L-0601	06 - FINE SCREENING - LIME	208/120V Panelboard	Eaton	Mayer	PRL1A	LAT04380-016	\$253	5/25/2010
38	L-0602	06 - FINE SCREENING - LIME	208/120V Panelboard	Eaton	Mayer	PRL1A	LAT04380-017	\$311	5/25/2010
39	LCP-06	06 - FINE SCREENING - LIME	DCS Cabinet / System	Invensys	Invensys	N/A	N/A	\$120,000	5/25/2010
40	LCT-0601	06 - FINE SCREENING - LIME	Lighting Contactor	Cleveland Electric Compar	Cleveland Electric Compar	N/A	N/A	\$2,500	5/25/2010
41	M-06A11	06 - FINE SCREENING - LIME	Drum Screen No. 1	Eimco-Brackett Green	Eshelman Company	N/A	N/A	\$600,000	5/25/2010
42	M-06A21	06 - FINE SCREENING - LIME	Drum Screen No. 2	Eimco-Brackett Green	Eshelman Company	N/A	N/A	\$600,000	5/25/2010
43	M-06A51	06 - FINE SCREENING - LIME	Sampler	Teledyne ISCO	Pizzagalli	4700	209601282	\$3,000	5/25/2010
44	M-06C11	06 - FINE SCREENING - LIME	Silo No. 1 Vent Filter	Donaldson Torit	RDP Technologies	TBV200	2761598-1-Unit1	\$10,000	5/25/2010
45	M-06C12	06 - FINE SCREENING - LIME	Lime Feeder No. 1	RDP Technologies	TDH Company	0900	N/A	\$20,000	5/25/2010
46	M-06C13	06 - FINE SCREENING - LIME	Bin Activator No. 1	Metalfab Inc.	RDP Technologies	CD18-2000	908012	\$20,000	5/25/2010
47	M-06C22	06 - FINE SCREENING - LIME	Lime Slaker No. 1 Mixer	RDP Technologies	TDH Company	N/A	N/A	\$30,000	5/25/2010
48	M-06C31	06 - FINE SCREENING - LIME	Grit Separator No. 1	Kason	RDP Technologies	K40-1-SS	M8035	\$20,000	5/25/2010
49	M-06C42	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 1 Mixer	Sharpe Mixers	RDP Technologies	2E5-25	50763-2	\$30,000	5/25/2010
50	M-06D11	06 - FINE SCREENING - LIME	Silo No. 2 Vent Filter	Donaldson Torit	RDP Technologies	TBV200	2761598-1-Unit2	\$10,000	5/25/2010
51	M-06D12	06 - FINE SCREENING - LIME	Lime Feeder No. 2	RDP Technologies	TDH Company	0900	N/A	\$20,000	5/25/2010
52	M-06D13	06 - FINE SCREENING - LIME	Bin Activator No. 2	Metalfab Inc.	RDP Technologies	CD18-2000	908012	\$20,000	5/25/2010
53	M-06D22	06 - FINE SCREENING - LIME	Lime Slaker No 2 Mixer	RDP Technologies	TDH Company	N/A	N/A	\$30,000	5/25/2010

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1	TAG_NO	StructureTitle	EquipmentDescription	Manufacturer	Vendor	MODEL	SerialNumber	InstalledDate
54	M-06D31	06 - FINE SCREENING - LIME	Grit Separator No. 2	Kason	RDP Technologies	K40-1-SS	M8036	5/25/2010
55	M-06D42	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 2 Mixer	Sharpe Mixers	RDP Technologies	2E5-25	50763-1	5/25/2010
56	M-06E21	06 - FINE SCREENING - LIME	Air Compressor	Gardner Denver	Pizzagalli	CBSPLA, PL Series-3 - 30HPS	D066770	5/25/2010
57	M-06E31	06 - FINE SCREENING - LIME	Compressed air dryer	Quincy	Pizzagalli	RNC25A1	RG0J225B01A2NC09023	5/25/2010
58	M-06E51	06 - FINE SCREENING - LIME	Lime Unloading Blower	Aerzen	Pizzagalli	AMUSA GM035S-00	907444	5/25/2010
59	M-06F71	06 - FINE SCREENING - LIME	Fine Screen Monorail / Hoist	Acco	Pizzagalli	C2W/03	532/20/13354	5/25/2010
60	MAU-0601	06 - FINE SCREENING - LIME	Direct-fired makeup air unit	Reznor	Shumate	RDF180-3	BID827AN01696MV7	5/25/2010
61	MCC-0601	06 - FINE SCREENING - LIME	Motor Control Center	Eaton	Mayer	Freedom Series 2100	LAT04380 IT_013	5/25/2010
62	P-06B11	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 1	Haigh Engineering	Eimco-Brckett Green	Macipump 350	35454-H26215	5/25/2010
63	P-06B12	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 2	Haigh Engineering	Eimco-Brckett Green	Macipump 350	35454-H26214	5/25/2010
64	P-06B21	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 3	Haigh Engineering	Eimco-Brckett Green	Macipump 350	35454-H26213	5/25/2010
65	P-06B22	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 4	Haigh Engineering	Eimco-Brckett Green	Macipump 350	35454-H26216	5/25/2010
66	P-06E01	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 1	Watson Marlow	SPX 40		26779	5/25/2010
67	P-06E02	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 2	Watson Marlow	SPX 40		26780	5/25/2010
68	P-06E03	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 3	Watson Marlow	SPX 40		26789	5/25/2010
69	P-06E41	06 - FINE SCREENING - LIME	Lime Slur Additive Meter Pump No. 1	Watson Marlow	Watson Marlow	520UN/R2	110358	5/25/2010
70	P-06E42	06 - FINE SCREENING - LIME	Lime Slur Additive Meter Pump No. 2	Watson Marlow	Watson Marlow	520UN/R2	110359	5/25/2010
71	T-0601	06 - FINE SCREENING - LIME	Dry Type Transformer	Eaton	Mayer	H48M28T30EE	J08D00184	5/25/2010
72	T-0602	06 - FINE SCREENING - LIME	Dry Type Transformer	Eaton	Mayer	H48M47T30EE	J08L00574	5/25/2010
73	T-0603	06 - FINE SCREENING - LIME	Dry Type Transformer	Eaton	Mayer	H48M28F15EE	J08D00112	5/25/2010
74	T-06B10	06 - FINE SCREENING - LIME	Screenings Conditioning Tank No. 1	Haigh Engineering	Eimco-Brckett Green	1000 ACE Package	N/A	5/25/2010
75	T-06B20	06 - FINE SCREENING - LIME	Screenings Conditioning Tank No. 2	Haigh Engineering	Eimco-Brckett Green	1000 ACE Package	N/A	5/25/2010
76	T-06C11	06 - FINE SCREENING - LIME	Lime Silo No. 1	Imperial Industries	RDP Technologies	606512-0K34-11	150392-1	5/25/2010
77	T-06C21	06 - FINE SCREENING - LIME	Lime Slaker No. 1	Tekkem	RDP Technologies	PRS-2008	N/A	5/25/2010
78	T-06C41	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 1	RDP Technologies	TDH Company	N/A	N/A	5/25/2010
79	T-06D11	06 - FINE SCREENING - LIME	Lime Silo No. 2	Imperial Industries	RDP Technologies	606512-0K34-11	150392-2	5/25/2010
80	T-06D21	06 - FINE SCREENING - LIME	Lime Slaker No. 2	Tekkem	RDP Technologies	PRS-2008	N/A	5/25/2010
81	T-06D41	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 2	RDP Technologies	TDH Company	N/A	N/A	5/25/2010
82	T-06D51	06 - FINE SCREENING - LIME	Sulfamic Acid Feed Tank	Snyder Industries	Pizzagalli		N/A	5/25/2010
83	V-06A13	06 - FINE SCREENING - LIME	Screen No. 1 Spray Water Valve	Hayward	SIP	True Union	N/A	5/25/2010
84	V-06A23	06 - FINE SCREENING - LIME	Screen No. 2 Spray Water Valve	Hayward	SIP	True Union	N/A	5/25/2010
85	V-06A41	06 - FINE SCREENING - LIME	EQE / Fine Screen 30" Isolation Valve	DeZurik	Ecotech	9492401R001	854451-2	5/25/2010
86	V-06A42	06 - FINE SCREENING - LIME	Primary Sed. / Fine Screen 42" Flow Control	DeZurik	Ecotech	9492400R001	854451-1	5/25/2010
87	V-06A61	06 - FINE SCREENING - LIME	EQE / Fine Screen 18" Flow Control Valve	DeZurik	Ecotech		Tag# 1380279	5/25/2010
88	V-06A62	06 - FINE SCREENING - LIME	EQE / Fine Screen 12" Flow Control Valve	DeZurik	Ecotech		Tag# 1380278	5/25/2010
89	V-06B31	06 - FINE SCREENING - LIME	FSCR from Tank No. 1 to Inlet Box	Hayward	SIP	True Union	N/A	5/25/2010
90	V-06B32	06 - FINE SCREENING - LIME	FSCR to Liquid Separators No. 1 and 3	Hayward	SIP	True Union	N/A	5/25/2010
91	V-06B33	06 - FINE SCREENING - LIME	FSCR from Tank No. 2 to Inlet Box	Hayward	SIP	True Union	N/A	5/25/2010
92	V-06B34	06 - FINE SCREENING - LIME	FSCR to Liquid Separators No. 2 and 4	Hayward	SIP	True Union	N/A	5/25/2010
93	VFD-06E01	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 1 VFD	Benshaw Controls	Watson Marlow	N/A	E200814273A-1	5/25/2010
94	VFD-06E02	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 2 VFD	Benshaw Controls	Watson Marlow	N/A	E200814273A-2	5/25/2010
95	VFD-06E03	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 3 VFD	Benshaw Controls	Watson Marlow	N/A	E200814273A-3	5/25/2010
96	WCP-0601	06 - FINE SCREENING - LIME	DCS Workstation	Invensys		N/A	N/A	5/25/2010
97	WL-0601	06 - FINE SCREENING - LIME	Fixed Wall Louver	Ruskin	Shumate	ELF6375X	N/A	5/25/2010
98	WL-0602	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	5/25/2010
99	WL-0603	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	5/25/2010
100	WL-0604	06 - FINE SCREENING - LIME	Fixed Wall Louver	Ruskin	Shumate	ELF6375X	N/A	5/25/2010
101	WL-0605	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	5/25/2010
102	WL-0606	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	5/25/2010
103	WL-0607	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	5/25/2010
104	WL-0608	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	5/25/2010
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	TAG	InstrumentType	Building	Manufacturer	Model	SerialNo	Description	TotalPrice	Accuracy	Range	MinValue	MaxValue	EngUnits
1	AE/AIT-06F10	Gas Detector	06 - Fine Screen / Lime	Draeger	6810098 - Methane	ARZK-0284	Draeger Polytron IR 334 - Methane		< 2% LEL	0-100% LEL	0% LEL	100% LEL	% LEL
2	AE/AIT-06F10	Accessory	06 - Fine Screen / Lime	Draeger	6809750	N/A	Draeger Splash Guard		N/A	N/A	N/A	N/A	N/A
3	AE/AIT-06F10	N/A	06 - Fine Screen / Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
4	AE/AIT-06F10	Splash Guard	06 - Fine Screen / Lime	Draeger	6809780	N/A	Calibration Adapter for Splash Guard		N/A	N/A	N/A	N/A	N/A
5	AE/AIT-06F10	Digital Display	06 - Fine Screen / Lime	Precision Digital	PD677-N-EX	0902-97861-1-19	4-20mA Digital Display		N/A	0-100%	0%	100%	%
6	AE/AIT-06F10	N/A	06 - Fine Screen / Lime	Precision Digital	PDA-SSTAG	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
7	AE/AIT-06F10	Accessory	06 - Fine Screen / Lime	Draeger	6809450	N/A	Field Verification Cell		N/A	N/A	N/A	N/A	N/A
8	AE/AIT-06F10	N/A	06 - Fine Screen / Lime	Precision Digital	PDN-CALDATA	N/A	Calibration Services	\$ 3,000	N/A	N/A	N/A	N/A	N/A
9	AE/AIT-06F15	Gas Detector	06 - Fine Screen / Lime	Draeger	6810098 - Methane	ARZK-0177	Draeger Polytron IR 334 - Methane		< 2% LEL	0-100% LEL	0% LEL	100% LEL	% LEL
10	AE/AIT-06F15	Accessory	06 - Fine Screen / Lime	Draeger	6809750	N/A	Draeger Splash Guard		N/A	N/A	N/A	N/A	N/A
11	AE/AIT-06F15	N/A	06 - Fine Screen / Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
12	AE/AIT-06F15	Splash Guard	06 - Fine Screen / Lime	Draeger	6809780	N/A	Calibration Adapter for Splash Guard		N/A	N/A	N/A	N/A	N/A
13	AE/AIT-06F15	Accessory	06 - Fine Screen / Lime	Draeger	6809450	N/A	Field Verification Cell		N/A	N/A	N/A	N/A	N/A
14	AE/AIT-06F15	Digital Display	06 - Fine Screen / Lime	Precision Digital	PD677-N-EX	0902-97861-1-2	4-20mA Digital Display		N/A	0-100%	0%	100%	%
15	AE/AIT-06F15	N/A	06 - Fine Screen / Lime	Precision Digital	PDA-SSTAG	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
16	AE/AIT-06F15	N/A	06 - Fine Screen / Lime	Precision Digital	PDN-CALDATA	N/A	Calibration Services	\$ 3,000	N/A	N/A	N/A	N/A	N/A
17	AE/AIT-06F20	H2S Gas Detector	06 - Fine Screen / Lime	Draeger	4543070	ERAC-0174	Polytron ZxP TOX w/o Sensor and Relays		1.0 PPM	0-50 PPM	1.0 PPM	50.0 PPM	PPM
18	AE/AIT-06F20	H2S Gas Detector	06 - Fine Screen / Lime	Draeger	6809610	ARAA-0217	H2S Electrochemical Sensor		1.0%	0-50 PPM	0%	100%	PPM
19	AE/AIT-06F20	Accessory	06 - Fine Screen / Lime	Draeger	4509315	N/A	Splash Guard		N/A	N/A	N/A	N/A	N/A
20	AE/AIT-06F20	Mounting Kit	06 - Fine Screen / Lime	Draeger	4520315	N/A	Wall Mounting Kit w/ 15ft. Cable		N/A	N/A	N/A	N/A	N/A
21	AE/AIT-06F20	N/A	06 - Fine Screen / Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
22	AE/AIT-06F20	N/A	06 - Fine Screen / Lime	Draeger	SC04004	N/A	Warranty for Polytron ZxP TOX for 48 months	\$ 3,000	N/A	N/A	N/A	N/A	N/A
23	AE/AIT-06F25	H2S Gas Detector	06 - Fine Screen / Lime	Draeger	4543070	ERAC-0408	Polytron ZxP TOX w/o Sensor and Relays		1.0 PPM	0-50 PPM	1.0 PPM	50.0 PPM	PPM
24	AE/AIT-06F25	H2S Gas Detector	06 - Fine Screen / Lime	Draeger	6809610	ARAA-0162	H2S Electrochemical Sensor		1.0%	0-50 PPM	0%	100%	PPM
25	AE/AIT-06F25	Accessory	06 - Fine Screen / Lime	Draeger	4509315	N/A	Splash Guard		N/A	N/A	N/A	N/A	N/A
26	AE/AIT-06F25	Mounting Kit	06 - Fine Screen / Lime	Draeger	4520315	N/A	Wall Mounting Kit w/ 15ft. Cable		N/A	N/A	N/A	N/A	N/A
27	AE/AIT-06F25	N/A	06 - Fine Screen / Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
28	AE/AIT-06F25	N/A	06 - Fine Screen / Lime	Draeger	SC04004	N/A	Warranty for Polytron ZxP TOX for 48 months	\$ 3,000	N/A	N/A	N/A	N/A	N/A
29	FE/FT-06A02	Mass Flow Transducer/Disp	06 - Fine Screen / Lime	KROHNE Inc	VN304HA54300010100010	A0962701	IFC300F - Electromagnetic Flow Transducer		N/A	N/A	N/A	N/A	GPM
30	FE/FT-06A02	N/A	06 - Fine Screen / Lime	KROHNE Inc	42" - 48 months	N/A	Additional warranty		N/A	N/A	N/A	N/A	N/A
31	FE/FT-06A02	Mass Flow Sensor	06 - Fine Screen / Lime	KROHNE Inc	VN164Kw5AD031120110000	A0962701	Optiflux 2000 - 42" Mag Flow Meter	\$ 28,000	N/A	0-300 GPM	0 GPM	300 GPM	GPM
32	FE/FT-06A60	Mass Flow Transducer/Disp	06 - Fine Screen / Lime	KROHNE Inc	VN304HA54300010100010	TBA	IFC300F - Electromagnetic Flow Transducer		N/A	N/A	N/A	N/A	GPM
33	FE/FT-06A60	N/A	06 - Fine Screen / Lime	KROHNE Inc	24" - 48 months	N/A	Additional warranty		N/A	N/A	N/A	N/A	N/A
34	FE/FT-06A60	Mass Flow Meter	06 - Fine Screen / Lime	KROHNE Inc	VN154NA5AD031120110000	TBA	Optiflux 2000 - 24" Mag Flow Meter	\$ 11,000	N/A	0 GPM	0 GPM	0 GPM	GPM
35	FSL-06F30	Thermal Flow Switch	06 - Fine Screen / Lime	Fluid Components Int. Inc	FLT935-1B1A4FWC1B03000	304169	Thermal Flow Switch - 25"		+/- 5%	0-20 GPM	0 GPM	20 GPM	SFPS
36	FSL-06F30	N/A	06 - Fine Screen / Lime	Fluid Components Int. Inc	NIST-CAL	N/A	N.I.S.T. Cert Calibration	\$ 2,600	N/A	N/A	N/A	N/A	N/A
37	FSL-06F35	Thermal Flow Switch	06 - Fine Screen / Lime	Fluid Components Int. Inc	FLT935-1B1A4FWC1B03000	304170	Thermal Flow Switch - 25"		+/- 5%	0-20 GPM	0 GPM	20 GPM	SFPS
38	FSL-06F35	N/A	06 - Fine Screen / Lime	Fluid Components Int. Inc	NIST-CAL	N/A	N.I.S.T. Cert Calibration	\$ 2,600	N/A	N/A	N/A	N/A	N/A
39	LE/LIT-06A12A	Ultrasonic Level Transducer	06 - Fine Screen / Lime	Siemens Corporation	7ML5033-1AA0038 Z Y15	PBD/X3230217	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
40	LE/LIT-06A12A	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1930-1BJ	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
41	LE/LIT-06A12A	Ultrasonic Level Sensor	06 - Fine Screen / Lime	Siemens Corporation	7ML1100-0BA20	911175	ST-H Level Transducer (2" NPT - PTFE Face - 10m Cable)		N/A	0-20 ft	1 ft	26 ft	ft
42	LE/LIT-06A12A	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BH	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
43	LE/LIT-06A12A	Mounting Plate	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BT	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500	N/A	N/A	N/A	N/A	N/A
44	LE/LIT-06A12A	Ultrasonic Level Transducer	06 - Fine Screen / Lime	Siemens Corporation	7ML5033-1AA0038 Z Y15	PBD/X3230209	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
45	LE/LIT-06A12B	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1930-1BJ	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
46	LE/LIT-06A12B	Ultrasonic Level Sensor	06 - Fine Screen / Lime	Siemens Corporation	7ML1100-0BA20	911174	ST-H Level Transducer (2" NPT - PTFE Face - 10m Cable)		N/A	0-20 ft	1 ft	26 ft	ft
47	LE/LIT-06A12B	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BH	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
48	LE/LIT-06A12B	Mounting Plate	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BT	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500	N/A	N/A	N/A	N/A	N/A
49	LE/LIT-06A22A	Ultrasonic Level Transducer	06 - Fine Screen / Lime	Siemens Corporation	7ML5033-1AA0038 Z Y15	PBD/X3230 ???	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
50	LE/LIT-06A22A	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1930-1BJ	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
51	LE/LIT-06A22A	Ultrasonic Level Sensor	06 - Fine Screen / Lime	Siemens Corporation	7ML1100-0BA20	911176	ST-H Level Transducer (2" NPT - PTFE Face - 10m Cable)		N/A	0-20 ft	1 ft	26 ft	ft
52	LE/LIT-06A22A	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BH	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
53	LE/LIT-06A22A	Mounting Plate	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BT	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500	N/A	N/A	N/A	N/A	N/A
54	LE/LIT-06A22B	Ultrasonic Level Transducer	06 - Fine Screen / Lime	Siemens Corporation	7ML5033-1AA0038 Z Y15	PBD/X3230214	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
55	LE/LIT-06A22B	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1930-1BJ	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
56	LE/LIT-06A22B	Ultrasonic Level Sensor	06 - Fine Screen / Lime	Siemens Corporation	7ML1100-0BA20	911177	ST-H Level Transducer (2" NPT - PTFE Face - 10m Cable)		N/A	0-20 ft	1 ft	26 ft	ft
57	LE/LIT-06A22B	N/A	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BH	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
58	LE/LIT-06A22B	Mounting Plate	06 - Fine Screen / Lime	Siemens Corporation	7ML1830-1BT	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500	N/A	N/A	N/A	N/A	N/A
59	LE/LIT-06A22B							\$ 62,200					
60													
61													

+++ END OF SECTION 01780 +++

SECTION 01800

MAINTENANCE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor will be required to maintain stored and installed equipment and materials until Final Acceptance of the Work as defined by the General Conditions. Work included, but is not limited to:
 - 1. Perform all required maintenance.
 - 2. Repair and maintain protective coatings.
 - 3. Repair and replace scratched and damaged materials and equipment.
 - 4. Maintain and operate new equipment placed into service.
- B. Work per this Section starts on the date the equipment and materials are received, and continues until the Date of Final Acceptance.
- C. Contractor will monitor equipment storage and subsequently the operation and material functionality on a continual basis during the specified time period. Any deterioration of materials or malfunction of equipment will be followed by swift repair action to minimize the damage. Such repair may include repair and technical services by an independent contractor if the Engineer deems the Contractor's efforts are ineffective in correcting the problem.
- D. All costs for maintenance and repair of stored and installed equipment and materials, including costs from an independent contractor, during the specified time period will be the sole responsibility of the Contractor.

+++ END OF SECTION +++

SECTION 02000

SITE WORK

PART 1 - GENERAL

1.1 DESCRIPTION

These general site work requirements apply to all site work operations. Refer to specification sections for specific product and execution requirements.

1.2 QUALITY ASSURANCE

- A. Comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.
- B. Obtain and pay for all required inspections, permits, and fees. Provide notices required by governmental authorities.

1.3 PROJECT CONDITIONS

- A. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations at Contractor's expense.
- B. Arrange for disconnection and seal or cap all utilities and services designated to be removed before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved.
- C. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the Engineer and the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.
- D. Locate, protect, and maintain bench marks, monuments, control points and project engineering reference points. Reestablish disturbed or destroyed items at Contractor's expense.
- E. Perform site work operations and the removal of debris and waste materials to assure minimum interference with streets, walks, and other adjacent facilities.
- F. Obtain governing authorities' written permission when required to close or obstruct street, walks and adjacent facilities. Provide alternate routes

around closed or obstructed traffic ways when required by governing authorities.

- G. Control dust caused by work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.
- H. Protect existing buildings, paving, and other services or facilities on site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items shall be at Contractor's expense.
- I. Protect and maintain street lights, utility poles and services, traffic signal control boxes, curb boxes, valves and other services, except items designated for removal. Remove or coordinate the removal of traffic signs, parking meters and postal mail boxes with the applicable governmental agency. Provide for temporary relocation when required to maintain facilities and services in operation during construction work.
- J. Preserve from injury or defacement all vegetation and objects designated to remain.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment: As selected by Contractor, except as indicated in contract documents.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine the areas and conditions under which site work is performed. Do not proceed with the work until unsatisfactory conditions are corrected.
- B. Consult the records and drawings of adjacent work and of existing services and utilities which may affect site work operations.

END OF SECTION

SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered under this Section includes furnishing all labor, equipment and material required to remove, handle, crush and dispose of all equipment, materials and piping as shown on the Drawings, as directed by the Engineer or required for the completion of the Work, including all necessary excavation and backfilling.
- B. Where structural tile and brick are removed from existing structures, the work shall include all patching and reconditioning to restore the remaining tile or brick to its existing state and to provide a proper joint for joining the existing to new construction.
- C. Where concrete is cut from existing structures under this Section to permit setting or inserting pipes, flumes, equipment or appurtenances, the work shall include all re-concreting, dressing and finishing of openings to the required lines and dimensions or as necessary for the placing and fixing of inserts.
- D. The Contractor shall remove from existing structures and salvage, store or dispose of as specified hereinafter, all valves and piping, mechanical equipment, plumbing, heating, electrical, and ventilating fixtures, pipes, ducts, wires, and equipment, doors and windows, floor grating and cover plates, steel stairs, pipe railing and the like which are not to remain in service in the finished work, whether or not shown on the Drawings and/or specified herein.
- E. The work specified herein and shown on the Drawings is intended to give a general idea of the scope of this work but must not be construed as covering it entirely. The Contractor shall visit the site and judge the amount of work required and the problems anticipated in the performance of the work.
- F. Requirements for removal of pavement and abandonment of site utilities are specified in Section 02200.
- G. Buildings, facilities, and utilities to be selectively demolished are shown on the drawings.
- H. Many obstructions are not shown on the Drawings. Bidders are advised to carefully inspect the existing facilities before preparing the Bid Proposal.

This Contract shall include removal and replacement of obstructions such as electrical conduits and wire; water and waste piping; and similar items which may interfere with or hinder installation of equipment or materials; construction; or demolition required under the scope of the project. The Contractor shall coordinate all such demolition with Section 01100.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. The Contractor shall submit to the Engineer, prior to beginning work, a schedule of demolition and detail methods to be used on each facility to be demolished.
- B. The Contractor shall develop and submit a demolition plan which includes a demolition schedule comparable to a room finish schedule that covers:
 - 1. Each building surface affected by demolition.
 - 2. Proposed method and materials for demolition and patching.
 - 3. Catalog cuts and samples of the materials to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The Contractor shall provide all materials and equipment in suitable and adequate quantity as required to accomplish the work shown, specified herein, and as required to complete the project.
- B. All concrete, mortar, grout, and backfill used in patching, plugging or repairing shall comply in all respects with the applicable material requirements of these Specifications.
- C. Tile and brick used for the patching of existing masonry shall be of the same size, color and texture as the tile and brick which they abut. Salvageable tile and brick units which are removed in performing the required alterations may be reused if the exposed faces and edges of the units are in good condition. If satisfactory units are unobtainable through salvage operations, the Contractor shall furnish the required units of new material of similar quality, color and texture.

PART 3 - EXECUTION

3.1 GENERAL

A. Shutdown of Existing Operations and Utilities

1. The existing Sewer Facility is required to remain in service during construction of the new and modification of the existing facilities.
2. Total shutdown of the existing facilities to perform any new construction, to make the required structural or piping modifications, and, and/or to make or install the required electrical service or system modifications, will not be permitted and partial shutdown of the various existing facilities will be permitted as defined in Section 01011.
3. Prior to making any piping or structural connections or modifications to existing facilities, obtain specified timing and schedule approval.

B. Protection

1. Take care to prevent the spread of dust and flying particles. Sprinkle rubbish and debris with water to keep dust to a minimum.
2. Maintain adequate fire protection, including extinguisher and operative water-hose lines during demolition.

C. Personnel: Perform work by personnel experienced in this type work and in such a manner as to eliminate hazards to persons and property without interference with new work and with use of adjacent areas, public rights-of-way, utilities and structures.

3.2 CONCRETE DEMOLITION

A. Remove concrete using hand held equipment unless otherwise approved by the Engineer. All necessary precautions shall be taken during removal of concrete to prevent debris from falling and damaging adjacent piping, equipment, and facilities.

B. Where partial removal of a wall or floor is required, score the edge of the area to be removed (on all exposed surfaces) by saw cutting clean, straight lines to minimum 1 inch depth, but not greater than the depth of cover over the existing reinforcing steel and then chipping out the concrete. Saw cuts shall not extend beyond the limits of the opening. Corners shall be made true and square by combination of core drilling, chipping and grinding as necessary.

C. Where new concrete will be placed against a removal surface, preserve intact the existing reinforcing steel that would/will project into the new concrete. Allow the existing bars to project one lap length into the new concrete, or where this is not possible, weld new bars to the existing bars.

Welds shall develop the full strength of the existing bars. Welding shall comply with ASTM A 706.

- D. Where specifically shown or where the surface will be exposed, the removal may be accomplished by saw cutting completely through the concrete. The concrete around any exposed reinforcing steel shall be chipped back and the exposed reinforcing steel cut a minimum of 1-½-inches back from the finished face of the concrete. The face of the new concrete surface shall be grouted to fill all the depressions at cut reinforcing and any other voids and to cover the exposed aggregate and shall be trowel finished. Non-shrink grout shall be used as directed by the Engineer. Except as otherwise noted or required, concrete pads and bases for equipment and supports which are on grade shall be removed to a depth 6 inches below finished grade or 6 inches below the bottom of any new slab to be placed over it.
- E. Where concrete surfaces must be repaired, such as where removal of existing equipment pads or other demolition activity leaves a rough surface, they shall be repaired using a two component latex modified concrete bonded overlay. The materials, surface preparation and application shall be as recommended by Sika Corporation, Lyndhurst, N.J.; or Master Builders, Cleveland, Ohio; or equal; and as acceptable to the Engineer. In addition, the following requirements shall apply:
1. All edges of the repair area shall be cut vertical or slightly undercut to a ½-inch minimum depth and to wedge in the patch. No feather edges will be allowed. All edges shall be neat and straight.
 2. Remove concrete as necessary to create a minimum thickness patch of ½-inch, but not less than the minimum thickness recommended by the manufacturer.
 3. Concrete around exposed reinforcing bars shall be removed to a minimum of ¾-inch below the steel.
 4. The concrete surface to receive the overlay shall be roughened to a 3/16 inch profile, sandblasted to open the pores of the concrete, and cleaned of all loose material and laitance. Acid etch as necessary to remove any contaminants.
 5. A bonding grout, as recommended by the manufacturer, shall be uniformly brushed onto the surface, thoroughly coating all existing concrete and steel surfaces. Place the bonding grout only a few feet in front of the overlay concrete placement.
 6. The overlay shall be moist cured.
 7. Finish the overlay surface to be continuous with and to match the surrounding concrete surface.
- F. Preserving Existing Reinforcing: Where holes or openings are to be cut in existing concrete, preserve intact existing steel reinforcing. Where existing reinforcing must be removed, and where directed by the Engineer, new bars of sufficient size shall be spliced in and around the objects to be

inserted in the opening. Such shall be welded to the ends of existing bars. Welds shall be of such size and length as to develop the full strength of the existing bars.

3.3 MASONRY DEMOLITION

- A. Existing masonry to be removed shall be broken by air hammer and chisel in such manner as to leave adjoining portions of the structure in an undisturbed condition. In removing existing masonry, special care shall be taken to cut it as closely as possible to the required shape and with no projection into the neat outside line of the new work. The surfaces of all concrete and masonry shall be sufficiently rough to bond well with the new work.
- B. Contractor shall remove masonry within the limits of the opening or penetration to the nearest complete undamaged brick. Completed demolition of a masonry opening or penetration shall have no saw cut, chipped or otherwise damaged brick on its perimeter.
- C. Before any new masonry is built on or against existing concrete or masonry, the latter shall be scrupulously freed from all dirt, gravel, boulders, ice, snow or other objectionable substances.
- D. Existing reinforcement shall lap the reinforcement in the new masonry as shown on the Drawings or as directed by the Engineer.

3.4 REMOVAL OF EXISTING EQUIPMENT AND PIPING

- A. Equipment specified to be removed shall be removed completely, including all related accessories and concrete bases. Any embedded items such as anchor bolts, steel reinforcement, conduit and piping shall be cut off 1 inch below adjacent finished surfaces. The surface shall then be repaired to match adjacent surfaces in finish and appearance.
- B. Prior to removing any electrical equipment, all power to the equipment shall be shut off and properly locked out. All power and control wiring for the equipment shall then be disconnected at the starter or circuit breaker, as applicable, and removed from the conduit. Unused conduits shall be plugged.
- C. Blemishes or unsightly areas on walls and floors left after removal of equipment shall be cleaned and refinished as necessary to match adjacent surfaces.
- D. All holes and openings left after removal of equipment shall be filled or plugged to provide a neat and workmanlike appearance.

- E. Where piping designated for removal passes through concrete walls, the openings shall be suitably plugged or capped. Wall pipes and wall sleeves shall be sealed with blind flanges or mechanical joint plugs. Steel pipe sleeves shall be filled with non-shrink grout.
- F. Where equipment or piping designated for removal serves to support other equipment or piping designated to remain in service, the Contractor shall provide permanent supports in place of the removed equipment and piping. Where it is necessary to temporarily remove other equipment, piping or electrical work in order to gain access to an item of equipment or piping designated for removal, the Contractor shall restore all such equipment, piping or electrical work to its original condition.
- G. Abandoned Piping: Existing vitrified clay, concrete, PVC, cast iron and steel piping to be abandoned shall be cut and plugged or capped at each end. Where existing piping interferes with new piping or construction, it shall be removed beyond the limits required for the proper completion of the work and the open ends plugged or capped unless otherwise shown, lines shall be plugged or capped at least 1 inch behind or below finished building surfaces, and at least 12 inches below outside grade surfaces.
- H. Piping and Valving Reinstallation: The Contractor shall include in the Contract Price the cost of removing, refitting, and reinstalling certain pipe, fittings, and valves as shown on the Drawings.

3.5 PROTECTION OF WORK AND EXISTING FACILITY

- A. Perform the work in a manner that will not damage parts of the structure, facility, or system not intended to be removed. If in the opinion of the Engineer, the method of demolition or cutting may endanger or damage parts of the structure(s) or affect the operation of the facilities, promptly change the method when so notified by the Engineer. Perform all cutting required regardless whether such cutting is specifically indicated. Examine the existing structures, evaluate conditions to be encountered in accomplishing the work, and accommodate such requirements accordingly in the Bid Proposal. No blasting will be permitted.
- B. The Contractor shall exercise full care and shall use such methods and equipment during removal as well as maintain the usefulness of the various materials and equipment removed.
- C. Any damage done to structures or equipment during removal and any patching, plugging of holes or repairs necessitated because of removal of equipment and piping shall be repaired to the satisfaction of the Engineer and the cost thereof shall be included in the Contract Price.

3.6 DISPOSAL

- A. Disposal: All rubble and waste material shall be removed from each work area in order to provide a clean area for plant operations. Such removal and cleanup is to be completed upon conclusion of daily work, outage period, or a specific work period. Removal of waste material from the work areas constitutes physical removal of the debris, rubble, or waste from the building proper or work site to a proper storage container or stockpile. If material is stockpiled for later disposal, the stockpile location shall be as approved by the Engineer. Should stockpiling not be approved, an appropriate container may be used, or the Contractor may dispose of the material directly. If stockpiling is approved, disposal of stockpiled materials shall be accomplished at a frequency no less than weekly. Waste containers shall be located as approved by the Engineer. Waste material is considered to be any item or material that is removed from an existing condition and is not intended for reinstallation or salvage to the City. The Contractor shall be fully responsible for proper disposal of waste materials in accordance with all federal, state and local laws at no additional cost to the City.
- B. Contractor shall not dispose of any trash, material, equipment or litter into water reclamation center facilities or tanks. Contractor shall be responsible for any damage to any facilities, tanks or equipment by any such foreign material.

3.7 DISPOSITION OF SALVAGEABLE MATERIALS

- A. The Contractor shall submit a listing of all equipment which is shown to be removed, replaced or demolished, as indicated on the drawings which is in salvageable condition to the City for approval. Upon approval by the Engineer, the equipment approved as salvageable is to be salvaged and delivered to the City at a location to be designated at the project site by the Engineer. Equipment that shall be included in the listing includes (but is not limited to) pumps, valves, valve actuators, and instruments. Chemical PVC piping and FRP tanks are not to be considered for salvage. Loading and unloading shall be the responsibility of the Contractor.
- B. Equipment, as defined above, which is potentially salvageable shall be removed with care so as not to damage it for possible future use. Equipment shall be protected from dirt and the elements. Damage caused by the Contractor to equipment or material specified herein or indicated on the Drawings to be salvaged shall be replaced or repaired by the Contractor at no additional cost to the City. Reuse by the Contractor of salvaged material will not be permitted, except as specifically shown, specified herein, or as approved by the Engineer.

3.8 REHABILITATION

Certain areas of existing structures, piping, conduits and the like may be affected by work necessary to complete the modifications. The Contractor is responsible to rehabilitate those areas affected by the construction activities. Where existing equipment, equipment pads and bases, piping, piping supports, electrical panels and devices, conduits, and associated appurtenances are removed, the Contractor shall rehabilitate the affected areas such that little or no evidence of the previous installation remains. Remaining openings in concrete floors, walls, and ceilings from piping, conduit, and fasteners shall be filled with non-shrink grout and finished to match the adjacent area.

+++ END OF SECTION +++

SECTION 02115
CLEANING OF EXISTING PIPES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to clean pipelines, laterals and manholes.
- B. The cleaning Work required includes, but is not limited to, the following:
 - 1. Normal and heavy cleaning of existing sanitary sewers and laterals.
 - 2. Cutting of roots, grease, intruding sealing ring material and objects wedged in pipe joints from existing sanitary sewers and laterals.
 - 3. Removal of debris from sewers, manholes and laterals.
 - 4. Pressure washing of manhole walls, rungs, channel and bench.
 - 5. Disposal of waste and sediment.
 - 6. Cleaning up as the Work progresses and after the completion of all Work activities.
 - 7. All other Work required for the complete and satisfactory cleaning of the pipelines, laterals and manholes.

1.2 DEFINITIONS

- A. Normal cleaning – cleaning accomplished using water jets to scour and remove debris, grease, etc. from pipe and manhole in 1 to 3 complete passes of the nozzle.
- B. Root cutting and grease cutting – removal of roots larger than fine roots (as defined by PACP), hardened grease and intruding sealing ring material using cutting device.
- C. Heavy cleaning – cleaning accomplished using water jets to scour and remove debris, grease, etc. from pipe.

1.3 RELATED SECTIONS

Section 01500, Temporary Facilities.

1.4 GENERAL PRECAUTIONS

- A. Take precautions to protect sewer mains, laterals and manholes from damage that might be inflicted by the improper selection of the cleaning process or improper use of the equipment.
- B. When using hydraulically propelled devices, take precautions to ensure that the water pressure created does not cause damage or flooding to public or private property.
- C. Do not surcharge the sewer beyond the elevation that could cause overflow of sewage.
- D. Restore or repair any facility, which is damaged by CONTRACTOR actions at no cost to OWNER.

1.5 SUBMITTALS

- A. Specifications of the sewer cleaning equipment, including performance data on pump(s), hose diameter and length, tank capacity, and intended nozzles, root cutters, and debris baskets to be used on the job. Provide a chart that shows hose length and diameter versus volume and pressure.
- B. Lateral root removal and cleaning equipment (if applicable).
- C. Specifications on the equipment to be used to remove sediment and debris at the downstream manhole of each reach to be cleaned. Plan for disposal of debris and sediment removed from the cleaned pipelines, manholes and laterals.

1.6 QUALIFICATIONS

CONTRACTOR shall have experience in the cleaning of sewers. Documentation of experience shall be furnished to the ENGINEER upon request.

PART 2 - PRODUCTS

2.1 MAINLINE SEWER AND LATERAL CLEANING EQUIPMENT

- A. Cleaning equipment shall consist of truck-mounted, high velocity hydro-cleaning equipment. The equipment shall be provided with a minimum of 500 feet of one-inch inner diameter high-pressure hose with a selection of high velocity nozzles, as required for the cleaning operation. The various nozzles shall produce a scouring action from 10 to 45 degrees in all size sewers to be cleaned. Use nozzles matched to the pumps and the site-specific cleaning

requirements. Mount all nozzles with skids. A tiger tail or boot or downhole roller is required. A pressure gauge shall show operating pressure and a flow meter shall show flow rate. A table to translate shown pressures to delivery pressure shall accompany each cleaner unit.

- B. The pumps shall be capable of delivering a minimum 60 gpm at 2,000 psi at the nozzle head. A relief valve shall regulate pressure to the nozzle. The unit shall carry its own water tank, minimum of 1,000 gallons, auxiliary engines and pumps, and a hydraulically-driven hose reel.
- C. All controls shall be located so that the equipment can be operated above ground.
- D. Include appropriate adaptors, hoses and nozzles for cleaning laterals from mainline sewer. If utilizing an existing cleanout to clean lateral, provide equipment suitable for launching through cleanout to clean lateral.

2.2 MANHOLE CLEANING EQUIPMENT

Provide a high velocity washing hose for cleaning of the walls, rungs, channel and bench of the manhole. The hose shall have an adjustable nozzle capable of producing flow from a fine spray to a solid stream. All controls shall be located so that the equipment can be operated above ground.

2.3 VACUUM EQUIPMENT

- A. Provide equipment capable of removing all sand, dirt, rocks, roots, and other debris from the sewer and manhole.
- B. Provide screens to prevent scoured debris from migrating downstream of the limits of the Work.

2.4 CUTTING EQUIPMENT

Provide equipment that can mechanically cut roots and grease from lateral. For laterals without cleanouts, provide appropriate equipment that can be launched from the main to remove roots.

2.5 FLUSHING/CLEANING WATER

Provide all flushing water required for the cleaning of sewers either by truck or by an agreement with a potable water distribution system entity in accordance with Section 01500, Temporary Facilities, or in accordance

with surface water removal requirements. Provide proof that all flushing water was acquired lawfully.

2.6 DEBRIS BASKETS

Provide debris buckets with ¼" hole pattern or smaller sized to fit into the pipe being cleaned.

PART 3 - EXECUTION

3.1 MAINLINE SEWER CLEANING

- A. Thoroughly clean all pipeline reaches in order to permit an unrestricted inspection by closed circuit television. Particular emphasis shall be afforded to the removal of accumulated grease, roots, sand, rocks, sludge and other debris so that the video inspection will show clearly all portions of the pipe being inspected. Pressure at the nozzle shall be between 1500 psi and 2000 psi and flow rate shall be between 60 gpm and 75 gpm during cleaning operations in the sewer, unless otherwise approved by the ENGINEER. A lower pressure shall be used in areas known to be subject to backups through the laterals.
- B. Clean upstream reaches of sewers before the downstream reaches.
- C. Insert cleaning equipment into the downstream manhole of a given reach and pull the debris downstream. Reverse setups may be used if all debris is removed (i.e., no material is passed to the adjacent pipe segment).
- D. In mainlines, at a minimum, make one pass with a 30° - 45° nozzle at a rate not greater than 20 feet per minute, and one pass with a 10° - 15° nozzle at a rate not greater than 30 feet per minute. Reduce pressures and increase pull back rates in consultation with ENGINEER when cleaning through holes, breaks, and partial collapses in pipe so as to effectively clean pipe but minimize further damage pipe integrity.
- E. Rig winching equipment so as not to damage the existing pipeline or manholes.
- F. Continuously observe flow from cleaning operations. If any evidence of clean sand, dirt, or pipe bedding stone or of pipe fragments are observed, decrease jetting pressures, move nozzle away from likely source areas, and insert camera into sewer to

observe pipe conditions that might be contributing to these observations to minimize damage to pipe integrity caused by jetting operations. Alter cleaning pressures, pullback rates, and nozzles types to minimize potential for damage in consultation with ENGINEER.

- G. During cleaning, restrict the flow level in the pipe to a maximum of 30 percent of the pipe diameter. Take particular care to avoid flooding house connections during cleaning operations.
- H. Remove any blockages of lateral building connections resulting from the cleaning or other items of Work by cleaning of the building connection at no additional cost to the OWNER.

3.2 MANHOLE CLEANING

Wash the wall, bench, channel and rungs of the manhole to remove accumulated debris, grease, sediment, and grit.

3.3 ROOT, GREASE AND INTRUDING SEAL MATERIAL REMOVAL

- A. Remove all roots that could prevent the sealing of a packer, the proper application of chemical sealants or installation of a cured-in-place liner. Remove roots by suitable mechanical cutting devices or by hydraulic procedures such as with high-pressure jet cleaners. No roots of length greater than one and a half inches (1½-inch) shall remain following root removal procedures.
- B. Remove all grease which could prevent the sealing of a packer, the proper application of chemical sealants, or the installation of a cured-in-place liner. Use suitable mechanical cutting devices to remove grease.
- C. Remove objects wedged in pipe joints and intruding sealing ring material that interferes with the rehabilitation of sewer lines.

3.4 LATERAL CLEANING AND ROOT CUTTING

Remove accumulated grease, roots, sand, rocks, sludge and other debris so that the video inspection will clearly show all portions of the pipe being inspected.

3.5 DEBRIS REMOVAL

- A. Insert debris baskets into manholes toward which jetted flow is pushed. Record volume of debris removed. Where appropriate, utilize vacuum to remove solids.

- B. Remove all bricks, rocks, debris, sludge, dirt, sand, grease, roots, and other materials from the sewers and collect and remove the resulting debris from the downstream manholes of the sewer sections being cleaned. Utilize control measures in downstream manholes as necessary to prevent debris, sludge and other materials from passing through manholes to a downstream sewer section not scheduled for cleaning by CONTRACTOR that same day.
- C. When removing materials from manholes, return the discharge and drainage liquid stream to the downstream sewer and discharge downstream for disposal. Under no circumstances shall sewage or solids be dumped onto the ground surface, street, stream, ditches, catch basins, or storm drains. All solids and semi-solids shall be placed in a watertight container so that no spillage or leakage will occur, covered to minimize odors, and disposed by the CONTRACTOR. The CONTRACTOR is responsible for all operations and costs associated with removal, transportation, and disposal of debris collected during the cleaning operations.

3.6 FIELD QUALITY CONTROL

Acceptance of pipeline cleaning shall be made upon the successful completion of the television inspection documenting that all required debris, roots, and grease are removed to the satisfaction of the ENGINEER. If television inspection shows debris, solids, sand, grease, or grit remaining in the line, re-clean and re-inspect the pipeline at no additional compensation.

END OF SECTION

SECTION 02125

TEMPORARY AND PERMANENT EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SCOPE

- A. Work under this section includes furnishing all labor, materials, equipment and incidentals required to install and maintain temporary and permanent erosion and sedimentation controls as shown on the Drawings and as specified herein. Work under this Section also includes the subsequent removal of temporary erosion and sedimentation controls at completion of the project.
- B. Temporary and permanent erosion and sedimentation controls include mulching and grassing of disturbed areas and structural barriers at those locations which will ensure that erosion during construction will be maintained within acceptable limits. Acceptable limits are as established by the Georgia Environmental Protection Division (EPD) and applicable codes, ordinances, rules, regulations and laws of local and municipal authorities having jurisdiction.
- C. The temporary and permanent erosion and sedimentation control measures shown on the Drawings are minimum requirements. The Contractor shall notify the Engineer of any changes and/or additions to the erosion and sedimentation control measures necessary to accommodate the Contractor's means and methods of operation. Any additional erosion and sedimentation control measures required by the Contractor's means and methods of operation will be installed by the Contractor at no additional cost to the City.
- D. The Contractor shall be solely responsible for the control of erosion and sediment production within the Project area. The Contractor shall install controls that will ensure that storm water and drainage from the disturbed area of the Project site will be filtered or otherwise managed to minimize impacts on receiving waters and/or existing storm drains. Discharged waters shall be free of soil particles and shall meet all applicable permit turbidity requirements.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.

1.3 QUALITY ASSURANCE

- A. The Contractor shall designate a worksite erosion control supervisor. The supervisor shall have the responsibility and authority to coordinate all equipment, personnel and materials needed to maintain project site erosion and sediment control in accordance with the management practices and standards established in the Manual for Erosion and Sediment Control in Georgia, the Drawings and Specifications.
- B. Within 15 days after receipt of the Notice to Proceed, the Contractor shall submit the name and contact data for the designated erosion control supervisor. The supervisor shall be an individual with an active minimum Level 1 certification as issued by the Georgia Soil and Water Conservation Commission.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Silt fence: Silt fence shall be as detailed on the Drawings and shall meet the requirements of Section 171 – Silt Fence of the GDOT Department of Transportation Standard Specifications.
 - 1. Silt fence fabric shall conform to GDOT Standard Specification Section 881.2.07.
 - 2. Silt fencing shall conform to GDOT Standard Specification Section 894.
 - 3. Silt fence posts and bracing shall conform to GDOT Standard Specification Section 862.
- B. Hay bales shall be clean, seed-free cereal hay type, rectangular in shape.
- C. Woven wire fence backing shall be ½ inch, galvanized steel, chicken-wire mesh.
- D. Filter stone shall be crushed rock conforming to Georgia Department of Transportation Table 800.01, Size Number 57.
- E. Concrete block shall be hollow, non load bearing type.
- F. Concrete shall be 3000 psi in accordance with Section 03055, Concrete.
- G. Plywood shall be ¾ inch thick exterior type.

2.2 RIP RAP

- A. Use only one method throughout the Project.
- B. Stone Rip Rap shall consist of sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or greater. Rip rap shall have less than 66 percent wear when tested in accordance with AASHTO T 96. Unless shown on the Drawings or specified otherwise, stone rip-rap shall be type 3.
 - 1. Type 1 Rip Rap: The largest pieces shall have a maximum approximate volume of two cubic feet. At least 35 percent of the mass shall be comprised of pieces which weigh 125 pounds or more. The remainder shall be well graded down to the finest sizes. Rock fines shall comprise a maximum of 10 percent of the total mass. Rock fines are defined as material passing a No. 4 sieve. Rip rap size shall conform to Georgia Department of Transportation Standard Specification Section 805 - Stone Dumped Rip Rap, Type 1.
 - 2. Type 3 Rip Rap: The largest pieces shall have a maximum approximate volume of one cubic foot. At least 35 percent of the mass shall be comprised of pieces which weigh 15 pounds or more. The remainder shall be well graded down to the finest sizes. Rock fines shall comprise a maximum of 10 percent of the total mass. Rock fines are defined as material passing a No. 4 sieve. Rip rap size shall conform to Georgia Department of Transportation Standard Specification Section 805 - Stone Dumped Rip Rap, Type 3.

2.3 FILTER FABRIC

Filter fabric for use under rip-rap shall meet the requirements of GDOT Standard Specification Section 881.2.05 for plastic filter fabric.

2.4 CONSTRUCTION EXIT STONE

Stone shall be sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Aggregate size shall be in accordance with the National Stone Association Size R-2 (1.5 to 3.5-inch stone) or Type 3 Riprap as specified in paragraph 2.02 of this Section.

2.5 GRASS

- A. Permanent grass shall be of the same type that existed prior to construction.
- B. Water: Water shall be free of excess and harmful chemicals, organisms and substances which may be harmful to plant growth or obnoxious to

traffic. Salt or brackish water shall not be used. Water shall be furnished by the Contractor.

2.6 EROSION CONTROL FABRIC

Erosion control fabric shall be equal to Futerra Erosion Control Blanket manufactured by Profile Products LLC. Fabric shall be a non-woven erosion control/vegetation blanket comprised of wood fiber and crimped, interlocking synthetic fibers laminated by accelerated photodegradable polypropylene netting. Fabric shall be 100% bio-degradable and photo-degradable within 10 months of installation.

PART 3 - EXECUTION

3.1 GENERAL

- A. Basic Principles:
 - 1. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type and condition.
 - 2. Minimize the disturbed area and the duration of exposure to erosion elements.
 - 3. Stabilize disturbed areas immediately.
 - 4. Safely convey run off from the site to a stable outlet.
 - 5. Retain sediment on site that is generated on site.
 - 6. Minimize encroachment upon watercourses.
- B. Temporary Erosion and Sedimentation Control: Temporary erosion and sedimentation control procedures shall be directed toward:
 - 1. Preventing soil erosion at the source.
 - 2. Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
 - 3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.
- C. Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of waterways and to prevent erosion of the Project site.

3.2 SEDIMENTATION AND EROSION CONTROL MEASURES

- A. Temporary and permanent erosion and sedimentation control measures shall prevent erosion and prevent sediment from exiting the site. If, in the opinion of the Engineer, the Contractor's temporary erosion and sedimentation control measures are inadequate, the Contractor shall provide additional maintenance for existing measures or additional devices

to control erosion and sedimentation on the site at no additional cost to the Owner.

- B. All erosion and sedimentation control devices and structures shall be inspected by the Contractor at least once a week and immediately prior to and after each rainfall occurrence. Any device or structure found to be damaged shall be repaired or replaced by the end of the day. Sediment ponds shall be cleaned out prior to the silt reaching the height or elevation shown on the Drawings.
- C. All erosion and sedimentation control measures and devices shall be constructed and installed as shown on the Drawings or specified herein and maintained until adequate permanent disturbed area stabilization has been provided or permanent pavement has been installed and accepted by the Engineer. After adequate permanent stabilization has been provided or permanent pavement has been installed and accepted by the Engineer, all temporary erosion and sedimentation control structures and devices shall be removed.

3.3 SEDIMENT CONTROL

- A. Construction Exit:
 - 1. Construction exit(s) shall be placed as shown on the Drawings and as directed by the Engineer. A construction exit shall be located at any point traffic will be leaving a disturbed area to a public right-of-way, street, alley, sidewalk or parking area.
 - 2. Placement of Construction Exit Material: The ground surface upon which the construction exit material is to be placed shall be prepared to a smooth condition free from obstructions, depressions or debris. The plastic filter fabric shall be placed to provide a minimum number of overlaps and a minimum width of one foot of overlap at each joint. The stone shall be placed with its top elevation conforming to the surrounding roadway elevations. The stone shall be dropped no more than three feet during construction.
 - 3. Construction Exit Maintenance: The Contractor shall regularly maintain the exit with the top dressing of stone to prevent tracking or flow of soil onto public right-of-way and paved surfaces as directed by the Engineer.
 - 4. Construction Exit Removal: Construction exit(s) shall be removed and properly disposed of when the disturbed area has been properly stabilized, the tracking or flow of soil onto public right-of-way or paved surfaces has ceased and as directed by the Engineer.

- B. Sediment Barriers:

1. Sediment barriers shall include, but are not necessarily limited to, silt fences, hay bales, rock check dams and inlet sediment traps and any device which prevents sediment from exiting the disturbed area.
2. Silt fences, hay bales and rock check dams shall not be used in any flowing stream, creek or river.
3. Sediment barriers shall be installed as shown on the Drawings and as directed by the Engineer.
4. Sediment barriers shall be maintained to ensure the depth of impounded sediment is no more than one half of the original height of the barrier or as directed by the Engineer. Torn, damaged, destroyed or washed out barriers shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by the Engineer.
5. Sediment Barrier Removal:
 - a. Sediment barrier shall be removed once the disturbed area has been stabilized with a permanent vegetative cover or permanent pavement has been installed and the sediment barrier is no longer required as directed by the Engineer.
 - b. Accumulated sediment shall be removed from the barrier and removed from the site.
 - c. All non-biodegradable parts of the barrier shall be disposed of properly. The hay bales may be spread evenly across disturbed areas as a mulching material.
 - d. The disturbed area created by barrier removal shall be permanently stabilized.

3.4 EROSION CONTROL

A. Grassing

1. Grassing shall be as specified in paragraph 3.5 of this Section
2. Temporary Stabilization: Temporary stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Temporary stabilization shall be provided to any area which will not receive permanent stabilization within the next 7 calendar days. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
3. Permanent Stabilization:
 - a. Permanent stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Permanent stabilization shall be provided to all areas of land disturbance within seven calendar days of the completion of land disturbance for any area greater than 0.25 acre. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.

- b. Grass or sod removed or damaged in residential areas shall be replanted with the same variety within seven calendar days of the completion of work in any area.
- c. Where permanent stabilization cannot be immediately established because of an inappropriate season, the Contractor shall provide temporary stabilization. The Contractor shall return to the site at the appropriate season to provide permanent stabilization in areas that received only temporary stabilization.

B. Erosion Control Blanket:

- 1. Erosion control blankets shall be applied to sloped areas as indicated on the Drawings and where in excess of 2 to 1 slope. Blankets shall be laid on finished grades that have been seeded, insuring good contact with the soil. Soil surface shall be smooth and free of rocks, roots, debris and other obstructions.
- 2. Secure blankets with biodegradable staples or stakes at the top of slopes in a 6-inch deep x 6-inch wide anchoring trench. Secure blankets with staples or stakes per the manufacturer's recommendations, increasing the spacing at overlapping edges. Blankets shall be overlapped by a minimum of 8-inches. Provide a 6-inch deep x 6-inch wide anchoring trench at the toe of the slope or shoreline.

3.5 GRASSING

A. General:

- 1. Refer to Section 02933, Seeding and Sodding for detailed specifications on permanent seeding.
- 2. When final grade has been established, all bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized and mulched in an effort to restore to a protected condition.
- 3. Specified permanent grassing shall be performed at the first appropriate season following establishment of final grading in each section of the site.
- 4. All references to grassing, unless noted otherwise, shall relate to establishing permanent vegetative cover as specified herein for seeding, fertilizing, mulching, etc.
- 5. Permanent grassing shall be of a perennial species.

- B. Grassing activities shall comply with Section 02933, Seeding and Sodding, and the Manual for Erosion and Sediment Control in Georgia; specifically for the selection of species, planting dates and application rates for seeding, fertilizer and mulching. Where permanent vegetative cover (grassing) cannot be immediately established (due to season or other

circumstances), the Contractor shall provide temporary vegetative or mulch cover.

3.6 RIP-RAP

- A. Unless shown otherwise on the Drawings, rip-rap shall be placed at all points where banks of streams or drainage ditches are disturbed by excavation, or at all points where their natural vegetation is removed. Carefully compact backfill and place rip rap to prevent subsequent settlement and erosion. This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing a stream or drainage ditch.
- B. When trenching across a creek, place rip-rap a distance of 10 feet upstream and 10 feet downstream from the top of the trench excavation. Place rip rap across creek bottom, across creek banks and extend rip-rap placement five feet beyond the top of each creek bank.
- C. Preparation of Foundations
 - 1. The ground surface upon which the rip rap is to be placed shall be brought in close conformity to the correct lines and grades before placement is commenced. Where filling of depressions is required, the new material shall be compacted with hand or mechanical tampers.
 - 2. Unless at creek banks or otherwise shown or specified, rip-rap shall begin in a toe ditch constructed in original ground around the toe of the fill or the cut slope. The toe ditch shall be two feet deep in original ground, and the side next to the fill or cut shall have that same slope. After the rip-rap is placed, the toe ditch shall be backfilled.
- D. Placement of Filter Fabric
 - 1. The surface to receive fabric shall be prepared to a relatively smooth condition free from obstructions, depressions and debris. The fabric shall be placed with the long dimension running up the slope and shall be placed to provide a minimum number of overlaps. The strips shall be placed to provide a minimum width of one foot of overlap for each joint. The filter fabric shall be anchored in place with securing pins of the type recommended by the fabric manufacturer. Pins shall be placed on or within 3 inches of the centerline of the overlap. The fabric shall be placed so that the upstream strip overlaps the downstream strip. The fabric shall be placed loosely so as to give and therefore avoid stretching and tearing during placement of the stones.
 - 2. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals or other contaminants. Any contaminated fabric or any fabric damaged during its installation

or during placement of rip-rap shall be removed and replaced with uncontaminated and undamaged fabric at no expense to the City.

E. Placement of Rip-Rap

1. The rip-rap shall be placed on a 6 inch layer of soil, crushed stone or sand overlaying the filter fabric. This 6 inch layer shall be placed to maximize the contact between the soil beneath the filter fabric and the filter fabric. Rip-rap shall be placed with its top elevation conforming to the finished grades or the natural slope of the stream bank and stream bottom.
2. The stones shall be dropped no more than 3 feet during construction.
3. Stone rip-rap shall be dumped into place to form a uniform surface and to the thickness specified on the Drawings. The thickness tolerance for the course shall be -6 inches and +12 inches. If the Drawings do not specify a thickness, the course shall be placed to a thickness of not less than 18 inches.

3.7 CLEAN UP

Remove and dispose of all excess erosion and sedimentation control devices and materials when no longer needed or at the completion of construction as directed by the Engineer.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this Section includes earthwork and related operations, including, but not limited to; excavating all classes of material encountered; trenching; handling; storage; transportation; and disposal of all excavated and unsuitable material; construction of fills and embankments; backfilling around structures; backfilling all pits; compacting; all sheeting; shoring and bracing; preparation of subgrades; surfacing and grading; and any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the Work.
- B. The Contractor shall provide all services, labor, materials, and equipment required for all earthwork and related operations necessary or convenient to the Contractor for furnishing complete Work as shown on the Drawings or specified in these Contract Documents.
- C. Related Work specified elsewhere:
 - 1. Section 01410 – Testing Laboratory Services
 - 2. Section 02125 - Erosion and Sedimentation Control
 - 3. Section 02575 - Removing and Replacing Pavement

1.2 GENERAL

- A. Safety: Comply with local regulations and with provisions of the “Manual of Accident Prevention in Construction” of the Associated General Contractors of America, Inc. Occupational Safety and Health Act (OSHA) and all other applicable safety regulations.
- B. The elevations shown on the Drawings as existing are taken from the best available data and are intended to give reasonable information about the existing elevations. The Contractor shall verify conditions to determine the exact quantities of excavation and fill required.
- C. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- D. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the City. All damage caused by erosion or other construction operations shall be repaired by the

Contractor using material of the same type as the damaged material at no cost to the City.

- E. The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can flow uninterrupted in existing open ditches or channels; other surface drains; or temporary drains.
- F. No classification of excavated materials will be made, except for rock excavation. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the Work, regardless of the type, character, composition or condition thereof.
- G. The soil testing will be performed by the Contractor's testing laboratory. As a minimum at least one density test shall be performed for every 5,000 square feet of fill area and every two feet of fill lift.
- H. Should the Owner choose to conduct its own testing, the Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests. The cost of all retests made necessary by the failure of materials supplied by the Contractor, his agents or subcontractors, to conform to the requirements of these Contract Documents shall be paid by the Contractor. Contractor shall provide at least 24 hours advance notice of earthwork operations to the Testing Laboratory. Testing Laboratory shall provide reports to the Engineer with copies to the Contractor certifying (and sealed by a Registered Georgia Engineer) that earthwork is in conformance with the plans and specifications. The Testing laboratory shall witness the placement of all fill, unless otherwise directed by the Engineer.
- I. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations, and shall be conducted in a manner acceptable to the Engineer.
- J. Stockpile Areas: Provided there is space available, stockpiling material may be on site.

1.3 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Copies of permits obtained by the Contractor for the work.

- B. Test results, certification of compliance, source and samples for all imported materials.
- C. Samples of fill materials to be used. Samples shall be submitted 2 weeks in advance of use and shall consist of 0.5 cubic feet of each type of material.
- D. Test reports for compaction.

1.4 QUALITY ASSURANCE

Reference Standards. Comply with all Federal, State and local laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. ASTM C136-84a, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D1556-82, Test Method for Density of Soils in Place by the Sand Cone Method.
- C. ASTM D1557-78, Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in. (457-mm Drop).
- D. ASTM D3107-88, Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Earthwork Materials
 - 1. Controlled Selected Fill:
 - a. Proposed fill soils shall be laboratory tested prior to construction use to determine their suitability. All fill material shall be subject to the approval of the Engineer.
 - b. Notification: For approval of imported fill material, notify the Engineer and Testing Laboratory at least three (3) weeks in advance of intention to import material, designate the proposed borrow area, and permit the Testing Laboratory to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material. Test results shall be submitted to the Engineer for approval. All fill shall be free of organic matter or debris, have a low to moderate plasticity, (PI<15) uniform composition, and be free of rock fragments greater

- than two inches in dimension. Soils selected for use as fill material shall also have a standard Proctor (ASTM D 698) maximum dry density of at least 90 pounds per cubic foot.
- c. All on-site fill material shall be soil exclusive of organic matter, frozen lumps or other deleterious substances.
 - d. It shall contain no rocks or earth clumps over 2-inches maximum in dimension except in cases with PVC or thermoplastic pipe in which case the maximum size shall be $\frac{3}{4}$ of an inch.
2. **Structural Fill and Structural Backfill:** Any structural fill used on site should be free of significant organic matter or debris, have a low to moderate plasticity (Plasticity Index < 20, Liquid Limit <50), exhibit relatively uniform composition, and be free of rock fragments greater than three inches in diameter. Soils selected for use as structural fill should have standard proctor (ASTM D698) maximum dry density of at least 90 pounds per cubic foot (pcf). Structural fill should be placed at a moisture content that corresponds to +/- 3 percent of the optimum moisture content, as determined by the standard proctor compaction test.
 - a. Select on site materials may be suitable. Testing and recommendation of suitability shall be made by the Testing Laboratory and submitted by the Contractor to the Engineer for approval.
 - b. Imported material shall be sand, uniformly graded crushed rock or other select material recommended by the Testing Laboratory and submitted by the Contractor to the Engineer for approval.
 - c. **Crushed Rock:** Crushed rock used for bedding and drainage stone shall conform to the Georgia Department of Transportation Standard Specifications for construction of Road and Bridges, Section 800 for No. 57 Stone.
 3. **Coarse Aggregate:** Coarse aggregate shall conform to the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, Section 800 for No. 57 Stone, Group II, and shall have the following gradation:

SIZE NO	NOMINAL SIZE SQUARE OPENINGS		AMOUNTS FINER THAN EACH LABORATORY SIEVE (SQUARE OPENINGS). %, BY WEIGHT										
	(1)	mm	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No-16	No. 50
			63 mm	50 mm	37.5mm	25 mm	19 mm	12.5 mm	9.5 mm	4.75 mm	2.36mm	1.18 mm	300 µm
57	1-No. 4	25 – 4.75	-----	-----	100	95-100	-----	25-60	-----	00-10	00-5	-----	-----

- (1) In inches, except where otherwise indicated. Numbered sieves are those of the United States Standard Sieve Series.

4. Top Soil: Dark organic weed free loam.

B. Sheeting, Bracing and Timbering: The Contractor shall furnish, place and maintain all sheeting, bracing and timbering required to properly support trenches and other excavations in open cut and to prevent all movement of the soil, pavement, structures, or utilities outside of the trench or pit.

1. General:

- a. All cofferdams, sheeting, bracing and timbering shall be designed, sealed and signed by a registered Professional Engineer in the State of Georgia at the Contractor's expense. A copy of the drawings and design computations shall be submitted to the Engineer for the project files.
- b. Sheeting, bracing and timbering shall be so placed as to allow the Work to be constructed to the lines and grades shown on the Drawings.
- c. If at any time the method being used by the Contractor for supporting any material or structure in or adjacent to any excavation is not reasonably safe the Engineer may require and the Contractor shall provide additional bracing and support necessary to furnish the added degree of safety. The Contractor shall provide such added bracing and support by such method as Contractor may elect to use, but the taking of such added precautions shall in no way relieve the Contractor of sole and final responsibility for the safety of lives, work and structures.
- d. All sheeting and shoring in contact with the concrete or masonry shall remain in place. The sheeting or shoring above the structure may remain in place or be cut off. No sheeting shall be left in place within three feet below the ground surface.
- e. There shall be no payment for sheeting, bracing, and timbering left in place.

2. Timber:

- a. Timber may be substituted for steel sheet piling when approved by the Engineer. Timber for shoring, sheeting or bracing shall be sound and free of large or loose knots and in good condition. Size and spacing shall be in accordance with OSHA regulations.
- b. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the work and adjacent property. Leave sheeting in place when it cannot be safely removed. Cut off sheeting left in place below the finished ground surface by three feet.

3. Steel Sheet Piling:

Steel sheet piling shall be the continuous interlock type. The weight, depth and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral or vertical movement at all times. In addition to the drawings and computations, the Contractor shall provide closure and sealing details between sheet piling and existing facilities, as well as method of excavation within sheet piling to the Engineer for review before commencing with construction operations. Contractor shall be responsible for all damage to existing utilities and structures resulting from installation of sheet piling. Damage to existing utilities and/or structures resulting from installation of sheet piling shall be repaired at the Contractor's expense.

- C. Other Materials: All other materials not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to the prior approval of the Engineer.
- D. Stockpile area: The stockpile area shown on the drawings, or as directed by the Engineer, shall be used to stockpile soil material for backfilling around structures and to stockpile needed topsoil.

PART 3 - EXECUTION

3.1 GENERAL

- A. Benching of Slopes: When the embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when the embankment is to be built $\frac{1}{2}$ width at a time, the slopes that are steeper than 4:1 as measured at right angles to the embankment shall be continuously benched over those areas as the work is brought up in layers. Benching shall be of sufficient width to permit the operation of placing and compacting equipment. Each successive cut shall begin at the intersection of the original ground and the vertical side of the previous cut. Material thus cut shall be recompacted along with the new embankment material. Proof roll subgrade prior to placement of fill material.
- B. Topsoil:
 - 1. Remove all topsoil to a depth at which subsoil is encountered, from all areas, which are to be cut to lower grades or filled.
 - 2. Topsoil to be used for finish grading may be stored on the site. It shall be piled properly, sloped to drain and covered.
- C. Bracing and Sheeting:

1. Furnish, install, and maintain all sheeting, bracing, and shoring as may be required to properly support the sides of all excavations and to prevent all movement of earth, which could in any way injure the work, adjacent property, or workmen.
2. Properly support all trenches for duct bank installation so as to conform to all pertinent rules and regulations and these Specifications. All trenches deeper than 5 feet shall be shored unless cut to the angle of repose of the excavated soils.
3. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported and damage to the work and adjacent property.
4. Do not leave any sheeting or bracing in the trench or excavation after completion of the work, unless approved or instructed by the Engineer. The cost of removing sheeting or bracing shall be at the Contractor's expense.
5. All sheeting and shoring in contact with concrete or masonry shall remain in place. The sheeting and shoring above the structure may remain or be cut off. No sheeting or shoring left in place shall be within three feet below the ground surface.

D. Obstructions:

1. Remove and dispose of all trees, stumps, roots, boulders, pavement, pipes and the like, as required for the performance of the work.
2. Exercise care in excavating around catch basins, inlets, manholes, piping, duct banks, underground vaults, etc.
3. Avoid removing or loosening castings or pushing dirt into structures.
4. Damaged or displaced castings shall be repaired and replaced, and dirt entering the structures during the performance of the work shall be removed at no additional cost to the City.

E. Utilities to be Abandoned:

1. When pipes, conduits, sewers or other structures are removed from the trench leaving dead ends in the ground, such ends shall be fully plugged and sealed as indicated on the Drawings.
2. Abandoned structures such as manholes, catch basins or chambers shall be entirely removed unless otherwise specified or indicated on the Drawings.
3. All materials from abandoned utilities which can be readily salvaged shall be removed from the excavation and stored on the site at a location as directed by the Engineer.
4. All salvageable materials will remain the property of the City unless otherwise indicated by the Engineer.

F. Extra Earth Excavation:

When soft material, which, in the opinion of the Engineer is not suitable, is encountered in the bottom of a trench or underneath a structure, the soft material shall be removed and replaced with structural fill or coarse aggregate.

G. Cutting Paved Surfaces and Similar Improvements:

1. Remove existing pavement as necessary for installing utilities and appurtenances or as otherwise shown on the Drawings.
2. Before removing any pavement, mark the pavement neatly, paralleling pipe lines and existing street lines. Space the marks to match the width of the trench.
3. Sawcut the asphalt pavement along the marks before breaking away from the part of pavement that should remain.
4. Do not pull pavement with machines until completely broken and separated from pavement to remain.
5. Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement. Refer to Section 02575 for replacement of damaged or removed pavement.
NOTE: No additional payment will be made for removing and replacing damaged adjacent pavement.
6. Remove and replace sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.
7. The Contractor may tunnel under curbs that are encountered. Remove and replace any curb disturbed by construction to the nearest undisturbed joint.

H. Dewatering:

1. The proposed dewatering plan shall be submitted by the Contractor to the Engineer for approval at least ten (10) working days prior to the beginning of any excavation.
2. Furnish, install, maintain and operate necessary pumping and other equipment for dewatering the various parts of the Work and for maintaining the foundation and other parts free from water as required for constructing each part of the Work.
3. By the use of well points, pumps, tile drains or other approved methods, the Contractor shall prevent the accumulation of water in excavated areas. Should water accumulate, it shall be promptly removed.
4. Excavations shall be continuously dewatered to maintain a ground water level no higher than 3 feet below the lowest point in the excavation.
5. Piezometric observation wells shall be required to monitor the ground water level and to ensure proper dewatering prior to excavation below the static water table. The number of wells required will vary depending on the size and depth of structures and shall be included in the plan.

6. The cost for all dewatering and discharge shall be at the Contractor's expense and shall be considered incidental.

3.2 EXCAVATION

A. Method:

1. All excavation shall be by open cut from the surface except as indicated on the Drawings.
2. All excavations for appurtenances and structures shall be made in such manner and to such depth and width as will give ample room for building the structures and for bracing, sheeting, and supporting the sides of the excavation, for pumping and draining groundwater and wastewater which may be encountered, and for the removal from the trench of all materials excavated.
3. Water shall not be allowed to accumulate in excavations. Contractor shall provide sufficient temporary pumping to assure that surface and ground waters do not saturate foundation soils.
4. Take special care so that soil below the bottom of the structure to be built is left undisturbed.

B. Grades:

1. Excavate to lines and grades indicated on the Drawings.
2. Where excavation grades are not indicated on the Drawings, excavate as required to accommodate installation.

C. Disposal of Excavated Material:

1. Remove and legally dispose of all excavated material not needed to complete filling, backfilling, and grading.
2. Dispose of excess excavated material at locations secured by the Contractor and in accordance with all requirements of federal, state, county and municipal regulations. No debris of any kind shall be deposited in any stream or body of water, or on any street or alley. No debris shall be deposited on any private property except by written consent of the property owner. In no case shall any material be left on the Project site, or be buried in embankments or trenches on the Project site. With recommendation of the Testing Laboratory and approval by the Engineer, demolished, crushed concrete may be acceptable for use in fill areas.
3. Excavated materials shall be placed adjacent to the work to be used for backfilling as required.
4. Excavated materials shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and to not cause any drainage problems. Excavated material shall be placed so as to not damage existing landscape or man-made improvements. Surcharging of any bank is not allowed.

D. Rock Excavation:

1. Rock excavation shall mean rock requiring drilling and blasting that occupies an original volume of at least one (1) cubic yard. Rock shall be considered as material which cannot be removed with a crawler tractor equal to a D-8 Caterpillar, equipped with a single-tooth ripper or by an excavator trackhoe equal to a Caterpillar 225 rated with a $\frac{3}{4}$ cubic yard capacity with a bucket curling pullout capacity of 25,000 pounds.
2. Where rock is encountered within excavation for structures, it shall be excavated to the lines and grades indicated on the Drawings or as otherwise directed by the Engineer. The Contractor shall be responsible for obtaining any blasting permits required.
3. If excess excavation is made or the material becomes disturbed so as to require removal below final subgrade elevations or beyond the prescribed limits, the resulting space shall be refilled with Class B concrete in accordance with Section 03055, Concrete.

3.3 EXCAVATING FOR STRUCTURES

A. Excavation:

1. All excavation is unclassified and shall be included in the Contractor's Base Bid.
2. Excavation shall include all substances to be excavated. Excavation for structures shall be to limits not less than 2 feet outside wall lines, to allow for formwork and inspection.
3. Where rock excavation is carried below grade, the Contractor shall backfill to grade using concrete or structural fill.
4. Where unsuitable material is encountered, excavate material to a depth acceptable to the Engineer and fill with compacted structural fill as required.

B. Excavation for Foundations: Footings and slabs on grades shall rest on undisturbed earth, rock or compacted materials to ensure proper bearing.

1. Unsuitable Foundation Material
 - a. Any material, in the opinion of the Engineer, which is unsuitable for foundation shall be removed and replaced with coarse aggregate or structural fill material as directed by the Engineer.
 - b. No determination of unsuitability will be made until all requirements for dewatering are satisfactorily met.
2. Foundation in Rock: Foundations for a structure shall be on similar materials. Should excavation for a foundation be partially in rock, the Contractor shall undercut that portion of the rock 12 inches and bring the excavation to grade with compacted crushed stone.

C. Construction Observations:

All excavations should be examined by the Engineer prior to reinforcing steel placement to verify that the design bearing pressure is available. All excavations should be clean, level and free of ponded water, mud and loose, frozen or water-softened soils. If it is necessary for an excavation to remain open overnight, or if rain is imminent, a 3-to 4-inch thick "mud mat" of Class B concrete may be placed in the bottom of the excavation to protect the bearing soils until reinforcing steel and concrete can be placed.

D. Unsuitable Bearing:

If unsuitable bearing for foundations is encountered at the elevations indicated on the Drawings, the Engineer shall be notified immediately.

3.4 EXCAVATION BELOW GRADE AND REFILL

If the bottom of any excavation is taken out below the limits shown on the Drawings or specified, it shall be refilled to the bottom grade, at the Contractor's expense, except where rock or unsuitable soil is encountered. The refill shall be 6-inch layers of structural fill or other material satisfactory to the Engineer. The type of material to be used shall be the Engineer's option.

3.5 TRENCH EXCAVATION

- A. Trenches shall be excavated to the lines and grades shown on the drawings with the centerlines of the trenches on the centerlines of the pipes.
- B. The sides of all trenches shall be vertical to a minimum of one foot above the top of the pipe. Unless otherwise indicated on the drawings, the trench width shall be equal to the sum of the outside diameter of the pipe plus 2 feet, within a tolerance of ± 3 inches. This distance will be measured at an elevation in trench which is 12 inches above the top of the pipe when laid to grade.
- C. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the next higher class (load factor) of embedment or encasement for the full trench width as actually cut, at no additional cost to the Owner.
- D. The trenches shall be excavated to the required depth allowing for the placement of pipe bedding to the thickness shown on the drawings.
- E. Should the bottom of the trench become an unstable foundation for the pipe through the failure of the Contractor to adequately perform, the Contractor shall remove the unstable material and fill the trench to the proper subgrade with crushed rock. No extra compensation will be allowed for this material or work. Should the trench be inadvertently

excavated to a greater depth than necessary, crushed rock fill to the proper subgrade shall be provided at no additional cost to the Owner.

- F. Should the undisturbed material encountered at the grade depth constitute, in the opinion of the Engineer, an unstable foundation for the pipe, the Contractor shall be required to remove such unstable material and fill the trench to the proper subgrade with crushed rock.
- G. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water from running into the excavation.

3.6 BACKFILL AND FILL PLACEMENT

- A. Compaction of fill shall be accomplished by placing the fill material in horizontal lifts of eight-inches (8") maximum loose thickness and mechanically compacting each lift to at least the specified dry density.
- B. All fill placement shall be witnessed by an experienced soils technician of the Testing Laboratory and fill density and moisture tests for each lift shall be performed to verify that the specified degree of compaction is being achieved.
- C. Prior to placement of any material in embankments, the area within embankment limits shall be stripped of topsoil and all unsuitable materials removed as described under Excavation. Area to receive fill shall then be scarified to a depth of at least 6-inches.
- D. The fill shall be brought to the proposed elevation by placing and compacting only approved fill materials upon a subgrade approved by the Engineer.
- E. Fill materials shall be placed in continuous approximately horizontal layers extending the full width of the embankment cross-section and the full dimension of the excavation where practicable.
- F. The fill shall be placed at a moisture content that corresponds to +/- 3% of the optimum moisture content, as determined by the standard Proctor moisture-density relationship test.
- G. Compaction:
 - 1. The fill shall be uniformly compacted to a dry density that corresponds to at least 95% of the standard Proctor maximum dry density (ASTM D 698) of the fill soil.
 - 2. The upper twelve-inches (12") of fill beneath the structures and pavement areas shall be compacted to 98% of the standard Proctor maximum dry density.

3. Scarification and recompacting of the upper fill soils immediately prior to the slab-on-grade and/or pavement construction shall be required.
 4. Compaction of embankments shall be by sheepsfoot rollers with staggered uniformly spaced knobs and suitable cleaning devices. The projected area of each knob and the number and spacing of the knobs shall be such that the total weight of the roller and ballast when distributed over the area of one (1) row of knobs shall be 250 psi. Placement and compaction of materials shall extend beyond the final contours sufficiently to ensure compaction of the material at the resulting final surface. Final contours shall then be achieved by a tracked bulldozer or grader shaping the face of the embankment.
 5. The backfill placement in trenches and behind structures shall be uniformly compacted to a dry density that corresponds to at least 95% of the standard Proctor maximum dry density (ASTM D 698) of the fill soil. In confined areas requiring portable compaction equipment, the fill material shall be placed in horizontal lifts of four-inches (4") maximum loose thickness.
 6. If tests indicate that the density of backfill, is less than that specified, the area shall be either be recompacted or undercut, filled, and compacted until specified density is achieved.
- H. Final Grading: Upon completion of construction operations, the area shall be graded to finish contour elevations and grades shown on the Drawings. Graded areas shall be made to blend with remaining ground surfaces. All surfaces shall be left smooth and free to drain.
- I. Moisture:
1. If fill material is too wet, provide and operate approved means to assist the drying of the fill until suitable for compaction.
 2. If fill material is too dry, provide and operate approved means to add moisture to the fill layers.
- J. Proofrolling:
- All areas where pavement or structures are to be built on compacted fill (and other areas indicated on the Drawings), shall be proofrolled to detect soft spots prior to the placement of fill material or construction of foundations.
1. Proofrolling shall consist of the moving a 20-30 ton loaded dump truck or pneumatic tire roller over the subgrade after the subgrade is shaped. Proofrolling shall be witnessed by the Engineer.
 2. Pneumatic-tired rollers shall have not fewer than four pneumatic tired wheels which shall be of such size and ply that tire pressures can be maintained between 80 and 100 pounds per square inch for 25,000 pound wheel load during rolling operations. Unless otherwise required, rolling shall be done with tires inflated to 90

psi. The roller wheels shall be located abreast in a rigid steel frame. Each wheel shall be loaded with an individual weight box so that each wheel will bear an equal load when traversing uneven ground. The weight boxes shall be suitable for ballast loading such that the load per wheel shall be 25,000 pounds. The spacing of the wheels shall ensure that the distance between the nearest edges of adjacent tires shall be not greater than one-half of the tire width of a single tire at the operating pressure for a 25,000 pound wheel load. The roller shall be operated not faster than 5 feet/second.

3. Subgrade shall be proofrolled with 6 passes. Depressions that develop during the proofrolling operation shall be filled with suitable material and those filled areas shall be proofrolled with 6 passes. If, after having been filled and proofrolled, the subgrade still contains depressions, the soil shall be undercut to the full depth of the soft material, or 5 feet, whichever is less, backfilled, and rolled to achieve a compacted subgrade.
4. After the proofrolled subgrade has been accepted by the Engineer, the surface of the subgrade shall be finish rolled with a smooth steel wheel roller weighing not less than 10 tons. Finished surface of the subgrade shall be within a tolerance of 0.04 feet at every point.
5. Conduits, pipes, culverts and underdrains shall be neither disturbed nor damaged by proofrolling operations. Rollers shall neither pass over, nor approach closer than 5 feet to conduits, pipes, culverts and underdrains unless the tops of those facilities are deeper than 3 feet.

- K. During wet or rainy periods, aeration (drying) shall be required to reduce the fill materials to the required moisture condition. During dry periods, water shall be added to achieve the proper moisture content for compaction. Wet silty soils shall require aeration prior to compaction even during dry periods.

3.7 BACKFILLING AROUND STRUCTURES

General:

- A. Remove debris from excavations before backfilling.
- B. Do not backfill against foundation walls until so instructed by the Engineer
- C. Wherever possible, backfilling shall be simultaneous on both sides of walls to equalize lateral pressures.

- D. Do not backfill on only one (1) side of vertically spanning walls unless walls are adequately shored or permanent construction is in place to furnish lateral support on both top and bottom of wall.

3.8 BACKFILLING TRENCHES

- A. The backfilling of sewer, water, storm, and other pipe line trenches shall be started immediately after the construction of same has been inspected by the Engineer. Selected backfill material shall consist of finely divided earth, stone dust, sand, crushed stone, or other approved material free from all wood, vegetative matter, debris and other objectional material and having scattered clods, stone or broken concrete less than 2 inches in maximum dimension.
- B. Backfill material shall be carefully placed in the trench on each side of the pipe in 6-inch layers for the full width of the trench and thoroughly and uniformly compacted by tamping or ramming as detailed in the construction plans.
- C. Backfilling shall be carried on simultaneously on both sides of the pipe and in a manner which will prevent injurious side pressures. If suitable select materials are not available from the trench excavation, the Contractor will be required to obtain the select material elsewhere.
- D. Across sidewalks and driveways and at any other places subject to vehicular traffic or other superimposed loads, trench backfill shall be compacted in 6 inch layers to the density of the original adjacent material for the full depth of the trench. The top 6 inches of backfill shall consist of uniformly graded crushed stone.
- E. Trenches under concrete slabs and footings of structures shall be filled with dry sand or crushed stone and tamped in 6 inch layers. Piping under concrete slabs and footings shall be encased (6 inches minimum) in concrete.

3.9 GRADING

- A. General:
 - 1. Perform all rough and finish grading required to attain the elevations indicated on the Drawings.
 - 2. Perform rough grading to an accuracy of plus or minus 0.10 feet.
- B. Grading Around Buildings: Control the grading around buildings so the ground is pitched to prevent water from running into the excavated areas of a building or damaging other site features.
- C. Treatment After Completion of Grading:

1. After grading is completed, permit no further excavation, filling or grading, except with the approval of the Engineer.
2. Use all means necessary to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.10 EXCESS WATER CONTROL

- A. Unfavorable Weather:
 1. Do not place, spread or roll any fill material during unfavorable weather conditions.
 2. Do not resume operations until moisture content and fill density are satisfactory to the Engineer.
 3. Any inundated area that freezes shall be removed and refilled at the Contractor's expense.
- B. Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collected in depressions.
- C. Pumping, Drainage and Dewatering:
 1. Provide, maintain and use at all times during construction adequate means and devices to promptly remove and dispose of all water from every source entering the excavations or other parts of the Work.
 2. Dewater by means which will ensure dry excavations, preserve final lines and grades, and not disturb or displace adjacent soil.
 3. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic or the work of other contractors, and in accordance with all pertinent laws, ordinances, and regulations.
 4. Do not overload or obstruct existing drainage facilities.

3.11 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments, which may occur within one (1) year after final acceptance of the Work by the City.
- B. The Contractor shall make, or will be caused to make, all repairs or replacements made necessary by settlement within thirty (30) days after receipt of written notice from the Engineer.

3.12 CLEANING

Upon completion of the work of this Section, remove all rubbish, trash and debris resulting from construction operations. Remove surplus equipment and tools.

Leave the site in a neat and orderly condition acceptable to the Engineer, and in conformance with the General Conditions of the Contract Documents.

+++ END OF SECTION +++

SECTION 02225

TRENCH EXCAVATION AND BACKFILL

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to perform all excavation and backfill required to complete the work.. The work shall include, but not be necessarily limited to, excavation and backfill for pipe and appurtenances, manholes and vaults, backfill and compaction, disposal of surplus and unsuitable material and all related work such as sheeting and bracing and dewatering.
- B. Work shall also include the removal of trees, stumps, brush, debris or other obstacles which remain after clearing and grubbing operations, which may obstruct the work, and the removal of all other materials, including rock, to the extent necessary to install the pipe and appurtenances in conformance with the approved lines and grades.
- C. Backfill shall include the refilling and compaction of the fill in the trenches and excavations up to the surrounding ground surface.
- D. The trench is divided into five specific areas:
 - 1. Foundation: The area beneath the bedding, sometimes also referenced to as trench stabilization.
 - 2. Bedding: The area above the trench bottom (or foundation) and below the bottom of the barrel of the pipe.
 - 3. Haunching: The area above the bottom of the barrel of the pipe up to a specified height above the bottom of the barrel of the pipe.
 - 4. Initial Backfill: The area above the haunching material and below a plane 12-inches above the top of the barrel of the pipe.
 - 5. Final Backfill: The area above a plane 12-inches above the top of the barrel of the pipe.
- E. The choice of method, means, techniques, and equipment rests with the Contractor. The Contractor shall select the method and equipment for trench excavation and backfill depending upon the: type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man-made improvements to be protected and available easement or right of way.

1.2 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards.
1. ASTM C33 – Standard Specification for Concrete Aggregates
 2. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 3. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 4. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using A Vibratory Table
 5. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
 6. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft³)
 8. ASTM D2937 – Standard Method for Density of Soil in Place by the Drive-Cylinder Method
- B. Density: All references to "maximum dry density" shall mean the maximum dry density defined by ASTM D698, except that for cohesionless, free draining soils "maximum dry density" shall mean the maximum index density as determined by ASTM D4253. Determination of the density of foundation, bedding, haunching, or backfill materials in place shall meet with the requirements of ASTM D1556, ASTM D6938 or ASTM D2937.
- C. Sources and Evaluation Testing: Testing of materials to certify conformance with the project requirements shall be performed by an independent testing laboratory.

1.3 SUBMITTALS

The Contractor shall submit record documents to the City DWM. The Contractor shall record locations of all pipelines installed referenced to survey benchmarks. The Contractor shall also include the locations of all underground utilities encountered and/or rerouted. The Contractor shall provide dimensions, materials, elevations, inverts and direction of flow. The Contractor shall use GPS technology or conventional survey methods to locate utilities.

1.4 SAFETY

Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavations" as described in OSHA publication 2226.

1.5 TESTING

- A. Testing shall be performed by an approved independent laboratory.
- B. Compaction testing shall be performed in accordance with the requirements of ASTM D1556 or ASTM D6938.

PART 2 PRODUCTS

2.1 TRENCH FOUNDATION MATERIALS

Crushed Stone: Crushed stone shall be utilized for trench foundation (trench stabilization) and shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

2.2 BEDDING AND HAUNCHING MATERIALS

- A. Water Mains
 - 1. Unless specified otherwise, bedding and haunching materials shall be suitable materials that have been excavated from the trench and are acceptable for use as pipe bedding and haunching. Materials shall be clean and free of rock larger than 2-inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes and other unsuitable materials.
 - 2. Crushed stone, if utilized for bedding and haunching, shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.
- B. Sewers and Storm Drains: Crushed stone utilized for bedding and haunching shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.
- C. Filter Fabric - Non-Woven Type
 - 1. Filter fabric associated with bedding shall be a UV stabilized, spun bonded, continuous filament, needle-punched, polypropylene, non-woven geotextile.
 - 2. The fabric shall have an equivalent open size (EOS or AOS) of 120 - 70. The fabric shall also conform to the minimum property values listed in the following table:

Fabric Property	Unit	Test Procedure	Average Value	
			Typical	Minimum
Weight	oz/yd ²	ASTM D 3776	8.3	
Thickness	mils	ASTM D 1777	105	
Grab Strength	lbs.	ASTM D 4632	240	210
Grab Elongation	%	ASTM D 4632	>50	50
Tear Strength	lbs.	ASTM D 4533	100	85
Mullen Burst	psi	ASTM D 3786	350	320
Puncture Resistance	lbs.	ASTM D 4833	115	100
Permittivity	sec ⁻¹	ASTM D 4491	1.7	
Water Permeability	cm/sec	ASTM D 4491	0.4	
Water Flow Rate	gpm/ft ²	ASTM D 4491	120	
UV Resistance (500 hrs)	%	ASTM D 4355	>85	
pH			2 - 13	

4. Filter fabric shall be equal to Polyfelt TS 700, Trevira 1125 or SuPac 7-MP.

2.3 INITIAL BACKFILL

- A. Initial backfill material shall be crushed stone or earth materials as specified for bedding and haunching materials.
- B. Earth materials utilized for initial backfill shall be suitable materials selected from materials excavated from the trench. Suitable materials shall be clean and free of rock larger than 2-inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping.
- C. If materials excavated from the trench are not suitable for use as initial backfill material, provide select material conforming to the requirements of this Section.

2.4 FINAL BACKFILL

- A. Final backfill material shall be general excavated earth materials, shall not contain rock larger than 2-inches at its greatest diameter, cinders, stumps, limbs, man-made wastes and other unsuitable materials.
- B. If materials excavated from the trench are not suitable for use as final backfill material, provide select material conforming to the requirements of this Section.

2.5 SELECT BACKFILL

Select backfill shall be materials that meet the requirements as specified for bedding, haunching, initial backfill or final backfill materials, including compaction requirements.

2.6 CONCRETE

Concrete for bedding, haunching, initial backfill, or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.

2.7 FLOWABLE FILL

- A. Controlled strength flowable fill shall be used as trench backfill when site conditions warrant.
- B. Controlled low strength flowable fill shall conform to Section 600 of the Georgia Department of Transportation Standard Specifications for Construction of Roads and Bridges – latest edition.
- C. Flowable fill design mix shall be for “excavatable” fill. Design mix shall be in accordance with Section 600.3.03 of the GDOT Standard Specifications.

2.8 GRANULAR MATERIAL

Granular material, where required for trench backfill, shall be sand, river sand, crushed stone or aggregate, pond screenings, crusher run, recycled concrete, or other angular material. Granular material shall meet gradation requirements for Size No. 57 or finer.

2.9 GRADED AGGREGATE BASE

Graded aggregate base shall be Class “A” meeting the requirements of the Georgia Department of Transportation Specification Section 815.01.

PART 3 EXECUTION

3.1 TRENCH EXCAVATION

- A. Topsoil and grass shall be stripped a minimum of 6-inches over the trench excavation site and stockpiled separately for replacement over finished graded areas.

- B. Trenches shall be excavated to the approved lines and grades with the centerlines of the trenches on the centerlines of the pipes and to the dimensions which provide the proper support and protection of the pipe and other structures and accessories.
- C. Trench Width:
1. The sides of all trenches shall be vertical to a minimum of one foot above the top of the pipe. The maximum trench width shall be equal to the sum of the outside diameter of the pipe plus two feet. The minimum trench width shall be that which allows the proper consolidation of the haunching and initial backfill material.
 2. Excavate the top portion of the trench to any width within the construction easement or right-of-way which will not cause unnecessary damage to adjoining structures, roadways, pavement, utilities, trees or private property. Where necessary to accomplish this, provide sheeting and shoring.
 3. Where rock is encountered in trenches, excavate to remove boulders and stones to provide a minimum of 12-inches clearance between the rock and any part of the pipe, manhole, vault or other structure.
- D. Trench Depth:
1. The trenches shall be excavated to the required depth or elevation which allow for the placement of the pipe and bedding to the approved dimensions and elevations.
 2. Where rock is encountered in trenches for pipelines, excavate to the minimum depth which will provide a clearance below the pipe barrel of 8-inches for pipe 21-inches in diameter and smaller and 12-inches clearance for larger pipe, manholes and other structures. Remove boulders and stones to provide above minimum clearances between the rock and any part of the pipe, manhole, vault or other structure.
- E. Excavated Materials:
1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Top soil shall be carefully separated and lastly placed in its original location.
 2. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause any drainage problems.

3. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements and also allow access to valves and hydrants.

3.2 SHEETING, SHORING AND BRACING

- A. Protection of the excavation against caving or settling of the banks shall be the sole responsibility of the Contractor.
- B. The Contractor shall protect the sides of his excavation by sheeting and bracing as may be necessary.
- C. The Contractor shall furnish, put in place and maintain sheeting and bracing required to support the side of the excavation and prevent loss of ground which could damage or delay the work or endanger adjacent structures or vehicular traffic. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- D. The Contractor shall leave in place to be imbedded in the backfill of the trench, all wood sheeting, bracing and other related items, or which the Contractor may determine to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Contractor may determine that timber used for sheeting and bracing in the trench be cut off at any specified elevation, after backfilling and tamping has reached this level.
- E. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction of other structures, utilities or property, whether public or private.
- F. The right of the City DWM to recommend sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the sides of the trench.
- G. The Contractor shall receive no payment, other than that included in the price to be paid for pipe, for any extra timber used for sheeting, bracing and other related items. The Contractor shall receive no payment for such timber which was used for the convenience of the Contractor.

3.3 TEST PITS

- A. Test pits for the purpose of locating underground utilities or structures as an aid in

establishing the precise location of new work may be excavated by the Contractor. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as hereinafter specified.

- B. Excavation and backfill of test pits shall be considered work incidental to the project and the cost shall be included in the appropriate bid item.
- C. If, for any reason, a test pit is left open for any period of time, it shall be properly barricaded and lighted by the Contractor.

3.4 ROCK EXCAVATION

- A. Definition of Rock: Any material which, cannot be excavated with conventional excavating equipment may be removed by drilling and blasting.
- B. Blasting:
 - 1. Exhaust other practical means of excavating prior to utilizing blasting as a means of excavation. Provide licensed, experienced workmen to perform blasting. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all buildings and structures from the effects of the blast. Repair any resulting damage. Employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.
- C. Removal of Rock: Dispose of rock off site that is surplus or not suitable for use as rip rap or backfill.
- D. The Contractor shall notify the City DWM prior to any blasting. Additionally, the Contractor shall notify the City DWM and local fire department before any charge is set.
- E. Contractor shall employ an independent, qualified specialty sub-contractor, to: monitor the blasting by use of a seismograph; identify the areas where light charges must be used, conduct pre-blast and post-blast inspections of structures, including photographs or videos; and maintain a detailed written log.

3.5 DEWATERING EXCAVATIONS

- A. Dewater excavation continuously to maintain a water level two feet below the bottom of the trench.
- B. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water running into the excavation.
- C. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates in excavations. Where the utility crosses

natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the Work will be prevented. Provision shall be made for the satisfactory disposal of surface water to prevent damage to public or private property.

- D. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete or backfilling.
- E. Where dewatering is performed by pumping the water from a sump, crushed stone shall be used as the medium for conducting the water to the sump. Sump depth shall be at least two feet below the bottom of the trench. Pumping equipment shall be of sufficient quantity and/or capacity to maintain the water level in the sump two feet below the bottom of the trench. Pumps shall be a type such that intermittent flows can be discharged. A standby pump shall be required in the event the operating pump or pumps clog or otherwise stop operation.
- F. Dewater by use of a well point system when pumping from sumps does not lower the water level two feet below the trench bottom. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. The casing shall be jetted into the ground, followed by the installation of the well point, filling casing with sand and withdrawing the casing.

3.6 TRENCH FOUNDATION AND STABILIZATION

- A. The bottom of the trench shall provide a foundation to support the pipe and its specified bedding. The trench bottom shall be graded to support the pipe and bedding uniformly throughout its length and width.
- B. If, after dewatering as specified above, the trench bottom is spongy, or if the trench bottom does not provide firm, stable footing and the material at the bottom of the trench will still not adequately support the pipe, the trench bottom shall be considered unsuitable and the Contractor will stabilize trench by over excavating trench bottom and filling with crushed stone.
- C. Where the replacement of unsuitable material with crushed stone does not provide an adequate trench foundation, the trench bottom shall be excavated to a depth of at least two feet below the specified trench bottom. Place filter fabric in the bottom of the trench and support the fabric along the trench walls until the trench stabilization, bedding, haunching and pipe have been placed at the proper grade. The ends of the filter fabric shall be overlapped above the pipe.
- D. Where trench stabilization is provided, the trench stabilization material shall be compacted to at least 95 percent of the maximum dry density, unless shown or specified otherwise.

3.7 BEDDING AND HAUNCHING

- A. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders, or large dirt clods.
- B. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to place and maintain the pipe at the proper elevation. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings. All bedding shall extend the full width of the trench bottom. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe. Adjustment to grade line shall be made by scraping away or filling with bedding material. Wedging or blocking up of pipe shall not be permitted. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except immediately at the joint.
- C. At each joint, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.
- D. After the pipe section is properly placed, add the haunching material to the specified depth. The haunching material shall be shovel sliced, tamped, chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders, or dirt clods.
- E. Pipe Bedding: The Contractor shall furnish and install pipe on the type and thickness of bedding specified in Part 2 of this section, minimum four inches.
- F. Manholes, Vaults and Other Structures: Excavate to a minimum of 12-inches below the planned elevation of the base of the manhole, vault or structure. Place and compact crushed stone bedding material to the required grade before constructing the manhole, vault or structure.
- G. Compaction:
 - 1. Bedding and haunching materials under pipe, manholes, vaults, structures and accessories shall be compacted to a minimum of 95 percent of the maximum dry density, unless shown or specified otherwise.
 - 2. Bedding and haunching materials within the limits of restrained joint pipe shall be compacted to a minimum of 95 percent of the maximum dry density, unless shown or specified otherwise.

3.8 INITIAL BACKFILL

- A. Initial backfill shall be placed to anchor the pipe, protect the pipe from damage by subsequent backfill and ensure the uniform distribution of the loads over the top of the pipe.
- B. Place initial backfill material carefully around the pipe in uniform layers to a depth of at least 12-inches above the pipe barrel. Layer depths shall be a maximum of 6-inches for pipe 18-inches in diameter and smaller and a maximum of 12-inches for pipe larger than 18-inches in diameter.
- C. Backfill on both sides of the pipe simultaneously to prevent side pressures.
- D. Compact each layer thoroughly with suitable hand tools or tamping equipment.
- E. Initial backfill shall be compacted to a minimum 95 percent of the maximum dry density, unless shown or specified otherwise. Initial backfill within the limits of restrained joint pipe shall be compacted to a minimum 95 percent of the maximum dry density, unless shown or specified otherwise.
- F. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this Section for initial backfill.

3.9 CONCRETE ENCASEMENT FOR PIPELINES

Where concrete encasement is used for pipelines, excavate the trench to provide a minimum of 12-inches clearance from the barrel of the pipe. Lay the pipe to line and grade on solid concrete blocks or solid bricks. In lieu of bedding, haunching and initial backfill, place concrete to the full width of the trench and to a height of not less than 12-inches above the pipe bell. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

3.10 FINAL BACKFILL

- A. Backfill carefully to restore the ground surface to its original condition.
- B. The top 6-inches of backfill shall be topsoil or graded aggregate base material, depending upon the trench location.
- C. Excavated material which is unsuitable for backfilling, and excess material, shall be disposed of in a manner approved by the Contractor. Surplus soil may be neatly distributed and spread over the site, if approved by the City DWM, except that surplus soil shall not be distributed and spread over the site in areas under Corps of Engineers jurisdiction. If such spreading is allowed, the site shall be left in a clean condition and shall not affect pre-construction drainage patterns. Surplus rock from the trenching operations shall be removed from the site.

- D. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this Section.
- E. Pipelines: After initial backfill material has been placed and compacted, backfill with final backfill material. Place backfill material in uniform layers, compacting each layer thoroughly as follows:
 - 1. In 6-inch layers, if using light power tamping equipment, such as a "jumping jack".
 - 2. In 12-inch layers, if using heavy tamping equipment, such as hammer with tamping feet.
- F. Manholes, Vaults and other Structures:
 - 1. Backfilling shall be carried up evenly on all walls of an individual structure simultaneously. A variation of 2-feet in elevation will be the maximum allowable. Backfill shall not be allowed against walls until the walls and their supporting slabs, if applicable, have attained sufficient strength.
 - 2. In locations where pipes pass through walls, the Contractor shall take the following precautions to consolidate the backfill up to an elevation of at least 2-feet above the bottom of the pipe:
 - a. Place fill in such areas for a distance of not less than 3-feet either side of the centerline of the pipe in level layers not exceeding 6-inches in depth.
 - b. Thoroughly compact each layer with a power tamper.
 - 3. Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against construction loads, hydraulic pressure and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.
- G. Final backfill shall be compacted to a minimum 95 percent of the maximum dry density, unless specified otherwise. Final backfill underlying pavement and backfill under dirt and gravel roads and within the limits of restrained joint pipe shall be compacted to a minimum 95 percent of the maximum dry density, unless specified otherwise.
- H. Concrete or bituminous asphalt removed during construction shall not be placed in backfill.
- I. The surface of filled areas shall be graded to smooth true lines in conformance with the approved grades or elevations.

3.11 ADDITIONAL MATERIAL

Where final grades above the pre-construction grades are required to maintain minimum cover, utilize excess material excavated from the trench, if the material is suitable. If excess excavated materials are not suitable, or if the quantity available is not sufficient, provide additional suitable fill material.

3.12 BACKFILL WITHIN RIGHT-OF-WAYS

Compact backfill within the limits of the any right-of-way including the backfill underlying pavement and sidewalks, and backfill under dirt and gravel roads to a minimum 95 percent of the maximum dry density.

3.13 BACKFILL WITHIN GEORGIA DOT RIGHT-OF-WAY

Backfill within the Georgia DOT right-of-way shall meet the requirements stipulated in the "Utility Accommodation Policy and Standards", published by the Georgia Department of Transportation.

3.14 FLOWABLE FILL

- A. Where flowable fill is utilized, excavate the trench to provide a minimum of 6-inches clearance on either side of the pipe barrel. Lay the pipe to line and grade on solid concrete blocks or bricks. In lieu of bedding, haunching and initial backfill, place flowable fill to the full width and depth of the trench.
- B. Flowable fill shall be protected from freezing for a period of 36 hours after placement. Minimum temperature of flowable fill at point of delivery shall be 50 degrees F.

3.15 COMPACTED GRANULAR MATERIAL

Where compacted granular material is required as initial and final backfill material, it shall be placed after bedding and haunching material specified elsewhere has been placed. Compacted granular material shall be compacted to a minimum 95 percent of the maximum dry density.

3.16 TESTING AND INSPECTION

- A. The soils testing laboratory is responsible for compaction tests in accordance with paragraph 1.02 of this Section.
- B. Compaction tests:
 - 1. Compaction tests will be required in existing or proposed streets, sidewalks, driveways and other existing or proposed paved areas at varying depths and at acceptable intervals as determined by the Contractor.

2. Minimum requirements for compaction testing shall be a minimum of one (1) test for each 400 feet or less of pipeline and one (1) test at each manhole, vault and other structure unless soil conditions or construction practices, in the opinion of the Engineer, warrant the need for additional tests. One (1) complete compaction test shall consist of individual tests in the same vertical plane over the installed pipe, beginning at a depth of 2-feet above the top of the pipe and at successive two feet vertical increments up to the top of the backfill.
 3. The City DWM may request additional compaction tests to be performed along the Project route.
- C. The soils testing laboratory shall be responsible for inspecting and testing stripped site, sub grades and proposed fill materials.
- D. The Contractor's duties relative to testing include:
1. Notifying laboratory of conditions requiring testing.
 2. Coordinating with laboratory for field testing.
 3. Providing excavation as necessary for laboratory personnel to conduct tests.
 4. Paying costs for additional testing performed beyond the required scope.
 5. Paying costs for re-testing where initial tests reveal non-conformance with specified requirements.
- E. Inspection
1. Earthwork operations, acceptability of excavated materials for bedding or backfill, and placing and compaction of bedding and backfill shall be subject to inspection by the Contractor.
 2. Foundations and shallow spread footing foundations shall be inspected by a geotechnical engineer, who shall verify suitable bearing conditions.
- F. Contractor shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state and federal authorities having jurisdiction.

+ + + END OF SECTION 02225 + + +

SECTION 02365

HELICAL PILE FOUNDATIONS

PART 1 - GENERAL

1.1 PURPOSE OF SPECIFICATION

- A. The purpose of this specification is to detail the furnishing of all materials, tools, equipment, labor supervision, and installation techniques necessary to install helical piles as detailed on the drawings, including connection details. This shall include provisions for load testing that may be part of the scope of work.

1.2 SCOPE OF WORK

- A. This work consists of furnishing all necessary, supervision, labor, tools, materials, and equipment to perform all work necessary to install the helical piles for the Jib Crane pile cap foundations located at The Flint River Pump Station for the City of Atlanta per the specifications described herein, and as shown on the drawings. The Contractor shall install a helical pile that will develop the load capacities as detailed on the drawings.

1.3 QUALIFICATIONS OF THE HELICAL PILE CONTRACTOR

- A. The helical pile Contractor shall be experienced in the installation of helical pile foundations and shall furnish all materials, labor, and supervision to perform the work. The Contractor shall provide names of on-site personnel materially involved with the work, including those who carry documented certification of helical pile training. At a minimum, these personnel shall include foreman, machine operator, and project engineer/manager.

The helical pile Contractor shall not sublet the whole or any part of the contract without the express written permission of the Owner.

1.4 DEFINITIONS

- A. Design Load (DL): Maximum anticipated service load applied to the helical anchor. Also known as the working load (WL).
- B. Helical Extension: Helical pile component installed immediately following the lead section, if required. This component consists of one or more helix plates welded to a central steel shaft of finite length.
- C. Helix Plate: Generally round steel plate formed into a ramped spiral. The helical shape provides the means to install the helical tieback anchor, plus

the plate transfers load to soil in end-bearing. Helix plates are available in various diameters and thicknesses.

- D. Lead Section: The first helical pile component installed into the soil, consisting of single or multiple helix plates welded to a central steel shaft. Helix plates provide end-bearing capacity.
- E. Plain Extension: Central steel shaft of finite length without helix plates. It is installed following the installation of the lead section or helical extension (if used). The units are connected with integral couplings and bolts. Plain extensions are used to extend the helix plates beyond the specified minimum depth and into competent load bearing stratum.
- F. Safety Factor: The ratio of the ultimate capacity to the working or design load of the helical pile.
- G. Working Load (WL): Equivalent term for Design Load.
- H. Ultimate Capacity (UC): Limit state based on the structural and/or geotechnical capacity of the ground anchor defined as the point at which no additional capacity can be justified.

1.5 ALLOWABLE TOLERANCES

- A. Centerline of helical pile shall not be more than 3 inches from indicated plan location.
- B. Helical pile plumbness shall be within 2° of design alignment.
- C. Top elevation of helical pile shall be within +1 inch to -2 inches of the design vertical elevation.

1.6 QUALITY ASSURANCE

- A. The Contractor shall employ an adequate number of skilled workers who are experienced in the necessary crafts and who are familiar with the specified requirements and methods needed for proper performance of the work of this specification.
- B. All helical piles shall be installed in the presence of a designated representative of the Owner unless said representative informs the Contractor otherwise. The designated representative shall have the right to access any and all field installation records and test reports.
- C. Helical pile components as specified therein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO

Standards Number shall be presented upon request to the Owner or their representative.

1.7 GROUND CONDITIONS

- A. The Geotechnical Report, including logs of soil borings as shown on the boring location plan, shall be considered representative of the in-situ subsurface conditions likely to be encountered on the project site. Said Geotechnical Report shall be used as the basis for helical pile foundation design using generally accepted engineering judgment and methods.

1.8 REFERENCED CODES AND STANDARDS

- A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. In case of conflict, the particular requirements of this specification shall prevail. The latest publication as of the issue of this specification shall govern, unless indicated otherwise.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.
 - 2. ASTM A36/A36M Structural Steel.
 - 3. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 4. ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 5. ASTM A252 Welded and Seamless Steel Pipe Piles.
 - 6. ASTM A775 Electrostatic Epoxy Coating.
 - 7. ASTM A193/A193M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
 - 8. ASTM A320/A320M Alloy-Steel Bolting Materials for Low Temperature Service.
 - 9. ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 10. ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality.
 - 11. ASTM A618 Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
 - 12. ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.
 - 13. ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium

- or Vanadium, and High-Strength Low-Alloy with Improved Formability.
- 14. ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load.
- 15. ASTM D3689 Method of Testing Individual Piles Under Static Axial Tensile Load.
- C. American Welding Society (AWS):
 - 1. AWS D1.1 Structural Welding Code – Steel.
 - 2. AWS D1.2 Structural Welding Code – Reinforcing Steel.
- D. American Society of Civil Engineers (ASCE):
 - 1. ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.
- E. Deep Foundations Institute (DFI):
 - 1. Guide to Drafting a Specification for High Capacity Drilled and Grouted Micropiles for Structural Support, 1st Edition, Copyright 2001 by the Deep Foundation Institute (DFI).
- F. Post Tensioning Institute (PTI):
 - 1. *Recommendations for Prestressed Rock and Soil Anchors*, Third Edition, Copyright 1996 By the Post-Tensioning Institute.
- G. Society of Automotive Engineers (SAE):
 - 1. SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners.

1.9 SUBMITTALS

- A. The Contractor shall submit a detailed description of the construction procedures proposed for use to the Owner for review. This shall include a list of major equipment to be used.
- B. The technical submittal shall include the following:
 - 1. Helical pile number, location, and pattern by assigned identification number if not indicated on plans
 - 2. Load required of each helical pile
 - 3. Type and size of central steel shaft
 - 4. Helix configuration (number and diameter of helix plates proposed)
 - 5. Minimum effective installation torque
 - 6. Minimum depth
 - 7. Helical pile attachment to structure relative to grade beam, column pad, pile cap, etc.
- C. The Contractor shall submit shop drawings for all helical pile components, including corrosion protection and pile top attachment to the Owner for

review and approval. This includes helical pile lead and extension section identification (manufacturer's catalog numbers).

- D. Work shall not begin until all the submittals have been received and approved by the Owner.

1.10 INSTALLATION RECORDS

- A. The Contractor shall provide the Owner copies of helical pile installation records within 24 hours after each installation is completed. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information:
 - 1. Name of project and Contractor
 - 2. Name of Contractor's supervisor during installation
 - 3. Date and time of installation
 - 4. Name and model of installation equipment
 - 5. Type of torque indicator used
 - 6. Location of helical pile by assigned identification number
 - 7. Actual central steel shaft type and configuration – including lead section (number and size of helix plates), number and type of extension sections
 - 8. Helical pile installation duration and observations
 - 9. Total length of installed helical pile
 - 10. Cut-off elevation
 - 11. Inclination
 - 12. Installation torque at one-foot intervals for the entire length
 - 13. Comments pertaining to interruptions, obstructions, rate of advancement or other relevant information

PART 2 - PRODUCTS

2.1 CENTRAL STEEL SHAFT

- A. The central steel shaft, consisting of lead sections, helical extensions, and plain extensions, shall be Galvanized Steel with both a Solid Square Shaft and a Pipe Shaft Type Helical Combination Pile as manufactured by AB Chance or approved equal.
 - 1. *Solid Square Shaft Material (1.5"x1.5")*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting dimensional and workmanship requirements of ASTM A29. The bar shall be modified medium carbon steel grade (similar to AISI 1044) with improved strength due to fine grain size.
 - a. Torsional strength rating = 5,500 ft-lb
 - b. Minimum yield strength = 70 ksi
 - 2. *Solid Square Shaft Material (1.5"x1.5")*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar shall be

High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size.

- a. Torsional strength rating = 7,000 ft-lb
 - b. Minimum yield strength = 90 ksi
3. *Solid Square Shaft Material (1.75"x1.75")*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar shall be High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size.
 - a. Torsional strength rating = 11,000 ft-lb
 - b. Minimum yield strength = 90 ksi
 4. *Solid Square Shaft Material (2.0"x2.0")*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar shall be High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size.
 - a. Torsional strength rating = 16,000 ft-lb
 - b. Minimum yield strength = 90 ksi
 5. *Solid Square Shaft Material (2.25"x2.25")*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar shall be High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size.
 - a. Torsional strength rating = 23,000 ft-lb
 - b. Minimum yield strength = 90 ksi
 6. *Pipe Shaft Material (2.875" O.D.)*: Shall be structural steel tube or pipe, seamless or straight-seam welded, per ASTM A500 Grade B. Wall thickness is 0.203" (schedule 40).
 - a. Torsional strength rating = 5,500 ft-lb
 - b. Minimum yield strength = 50 ksi
 7. *Pipe Shaft Material (2.875" O.D.)*: Shall be structural steel tube or pipe, seamless or straight-seam welded, per ASTM A500 Grade B. Wall thickness is 0.276" (schedule 80).
 - a. Torsional strength rating = 8,000 ft-lb
 - b. Minimum yield strength = 50 ksi
 8. *Pipe Shaft Material (3.5" O.D.)*: Shall be structural steel tube or pipe, seamless or straight-seam welded, ASTM A53, A252, A500, or A618. Wall thickness is 0.300" (schedule 80).
 - a. Torsional strength rating = 13,000 ft-lb
 - b. Minimum yield strength = 50 ksi

2.2 HELIX BEARING PLATE

- A. Helix plates material shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall conform to the following ASTM specifications.

1. *Solid Square Shaft Material (Torque $\leq 5,500$ ft-lb):* Per ASTM A572, or A1018, or A656 with minimum yield strength of 50 ksi. Plate thickness is 3/8”.
2. *Solid Square Shaft Material (Torque $\geq 5,500$ ft-lb):* Hot rolled steel sheet, strip or plate per ASTM A656 or A936 with minimum yield strength of 80 ksi. Plate thickness is 3/8” or 1/2”.
3. *Pipe Shaft Material (Torque $\leq 5,500$ ft-lb.):* Hot Rolled carbon steel, strip, or plate per ASTM A568 with minimum yield strength of 50 ksi. Alternate materials are A-36 or ASTM A572 Grade 50. Plate thickness is 3/8”.
4. *Pipe Shaft Material (Torque $\geq 5,500$ ft-lb.):* Per ASTM A36, or A572, or A1018, or A656 depending on helix diameter, with minimum yield strength of 80 ksi. Plate thickness is 3/8” or 1/2”.

2.3 BOLTS

- A. The size and type of bolts used to connect the central steel shaft sections together shall conform to the following ASTM specifications.
 1. Solid Square Shaft Material (Torque $\leq 7,000$ ft-lb): 3/4” diameter bolt per ASTM A320 Grade L7.
 2. Solid Square Shaft Material (Torque $\geq 7,000$ ft-lb): 7/8” – 1-1/4” per ASTM A193 Grade B7
 3. Pipe Shaft Material (Torque $\leq 13,000$ ft-lb): 3/4” diameter bolts (# of bolts per coupling depends on torque) per SAEJ429 Grade 5.
 4. SAE J429 Grade 5: Sy (min) = 92 ksi, Su (min) = 120 ksi

2.4 COUPLINGS:

- A. Couplings shall be capable of transmitting both the maximum installation torque from the tool string to the helix plates, and the maximum axial load from the top of the pile to the helical bearing plates.

2.5 PLATES, SHAPES, OR PIER CAPS:

- A. Structural steel plates and shapes for helical pile top attachments shall conform to ASTM A36 or ASTM A572 Grade 50.

2.6 CORROSION PROTECTION

- A. Galvanization: All helical pile material that is not encased in concrete shall be hot-dipped galvanized in accordance with ASTM A153 after fabrication.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

- A. Prior to commencing helical pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where helical pile installation may commence without restriction.
- B. The Contractor shall verify that all helical piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.
- C. In the event of a discrepancy, the Contractor shall notify the Owner. The Contractor shall not proceed with helical pile installation in areas of discrepancies until said discrepancies have been resolved.

3.2 INSTALLATION EQUIPMENT

- A. Shall be rotary type, hydraulic power driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.
- B. Equipment shall be capable of applying adequate down pressure (crowd) and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment and swing capacity at maximum installation torque to maintain proper helical pile alignment during installation. The application of bending stress to the pile during installation will not be permitted.

3.3 INSTALLATION TOOLING

- A. Shall consist of a Kelly Bar Adapter (KBA) and drive tool as appropriate for the central shaft of the helical pile under maximum installation torque and used in accordance with the manufacturers written installation instructions.
- B. Installation tooling should be maintained in good working order and safe to operate at all times. Flange bolts and nuts should be regularly inspected for proper tightening torque. Bolts, connecting pins, and retainers should be periodically inspected for wear and/or damage and replaced with identical items provided by the manufacturer. Heed all warning labels. Worn or damaged tooling should be replaced.
- C. A torque indicator shall be used during helical pile installation. The torque indicator shall be a device that directly measures torque and that is mounted in-line with the installation tooling. Devices that infer torque from hydraulic pressure will not be permitted.
 - 1. Shall be capable of providing continuous measurement of applied torque throughout the installation.

2. Shall be capable of torque measurements in increments of 200 ft-lb or less.
3. Shall be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

3.4 INSTALLATION PROCEDURE

- A. The helical pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.
- B. The lead section shall be positioned at the location as shown on the working drawings. Battered helical piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required batter angle shall be established. The helical pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of not to exceed 16 RPM's. The extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt(s) and nut torqued to 40 ft-lb.
- C. Sufficient down pressure shall be applied to uniformly advance the helical pile sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

3.5 TERMINATION CRITERIA

- A. The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.
- B. The minimum installation torque and minimum overall length criteria as shown on the technical submittal shall be satisfied prior to terminating the helical pile foundation installation.
- C. If the torsional strength rating of the central steel shaft and has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:
 1. Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:
 2. Remove the existing helical pile and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner.

- D. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:
1. Install the helical pile deeper using additional extension sections, or:
 2. Remove the existing helical pile and install a new one with additional and/or larger diameter helix plates.
 3. De-rate the load capacity of the helical pile and install additional helical screw foundation(s). The de-rated capacity and additional helical screw foundation location shall be subject to the review and acceptance of the Owner.
- E. If the helical pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the helical pile re-installed. If the obstruction can't be removed, the helical pile shall be installed at an adjacent location, subject to review and acceptance of the Owner.
- F. If the torsional strength rating of the central steel shaft and has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the helical pile to facilitate extension removal.
- G. The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

END OF SPECIFICATION

SECTION 02510
ASPHALT PAVING

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this Section includes, but it is not necessarily limited to, the furnishing and installation of all asphalt paving materials and pavement base materials as indicated on the Drawings and as necessary for the proper performance of this work.
- B. Related Work Specified Elsewhere:

Section 02200, Earthwork.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Batch design.
- B. Density and viscosity tests on each run.
- C. Weight slips for pavement base and asphalt paving materials.

1.3 QUALITY ASSURANCE:

- A. Unless otherwise indicated on the Drawings or herein specified, all work under this Section shall be performed in accordance with the current Georgia Department of Transportation Standard Specifications.
- B. Furnish weight slips for all material incorporated in the Project to verify that the required tonnage has been applied.

1.4 PRODUCT HANDLING:

- A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.
- B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to gain the approval of the Engineer at no additional cost to the City

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. General: All materials and products for the work under this Section shall conform to the current Georgia Department of Transportation Standard Specifications except as otherwise specified herein.
- B. Graded Aggregate Base: The sub-base shall be a minimum of 6-inches thick and a width equal to the width of the finished paving. Aggregate base shall be Class A meeting the requirements of the Georgia Department of Transportation Specification Section 815.01. Compact to at least 95% Standard Proctor Density. (ASTM D-698)
- C. Base: The base for all paved roadways shall conform to the requirements of the Georgia Department of Transportation Specifications for the Hot Mix asphalt Section 828 Type "B".
- D. Surface Course: The surface course for all pavement, including paint or tack coat when required by the Engineer, shall conform to the requirements of the Georgia Department of Transportation Specifications for Asphaltic Concrete, Section 828, Type "E".
- E. Prime coat shall be in accordance with Section 412 of the DOT Standard Specifications.
- F. Tack coat shall conform to Section 413 of the DOT Standard Specifications.

PART 3 - EXECUTION

3.1 EXCAVATING, FILLING AND GRADING

Perform excavating and filling in accordance with Section 02200 entitled "Earthwork" of these Specifications.

3.2 INSTALLATION

- A. Asphaltic construction shall be performed in accordance with Section 400 of the Georgia Department of Transportation "Standard Specifications, Construction of Roads and Bridges".
- B. Place each course in the required quantities so that when compacted, they will conform to the indicated grade, cross section and minimum thickness as specified or as indicated on the Drawings.

3.3 CLEANING

Prior to acceptance of the work of this Section, clean the pavement and related areas in accordance with the requirements of the General Conditions of the Contract Documents.

+++ END OF SECTION +++

SECTION 02521

CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for construction and reconstruction of concrete curb, concrete gutter and concrete combined curb and gutter at required locations, and to the lines, grades, cross section, form and dimensions of the existing curb and gutter.
2. Construction and reconstruction of concrete curb, gutter and combined curb and gutter shall include all necessary excavation, unless otherwise indicated, and subgrade preparation; backfilling, and final clearing up; and completion of all incidentals thereto and as directed by the Engineer.

1.2 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect concrete materials before, during and after installation and to protect the installed work and materials of all other trades.
- B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to the City.

1.3 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 CONCRETE REINFORCEMENT

Concrete reinforcement shall conform to Section 03055, Concrete

2.2 CONCRETE AND RELATED MATERIALS

- A. Concrete and related materials including, but not necessarily limited to, joint materials, membranes and curing compounds shall conform to Section 03055, Concrete.
- B. Class: All concrete shall be Class G 3,000 psi and conform to requirements of Section 03055, Concrete.
- C. Water used in mixing concrete shall be fresh, clean, potable water free from injurious amounts of oil, acid, alkali, vegetable, wastewater and/or organic matter.
- D. Admixtures shall meet the following requirements:
 - 1. Except as herein specified, no curative or hardening admixtures shall be used.
 - 2. An air entrainment agent capable of providing 3 to 6 percent air shall be used. Air entraining admixtures which are added to concrete mixtures shall conform to ASTM C260 for Air Entraining Admixtures for Concrete.
- E. Sub-base shall be constructed of granular material. Minimum depth of sub-base shall be 3- inches.
- F. Joint filler shall be a non-extruding joint material conforming to AASHTO M213 for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (non-extruding and resilient bituminous types). The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint unless otherwise specified by the Engineer.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: All earthwork shall be performed in accordance with Section 02225, Trench Excavation and Backfill and as specified in this Section.
- B. Backfilling
 - 1. After the concrete has set sufficiently, the spaces on both sides of the curb, gutter, and combined curb and gutter shall be backfilled, and the materials compacted and left in a neat and workmanlike condition.
 - 2. Curbs to be used in the construction of asphalt pavements shall be backfilled prior to placement of base material for asphalt pavement.

3.2 SUBGRADE PREPARATION

- A. The subgrade shall be formed by excavating to the required depth below the finished surface of the respective types, in accordance with the dimensions and designs indicated on the Drawings or as directed by the Engineer, and shall be of such width as to permit the proper installation and bracing of forms. The subgrade shall be compacted by hand tamping and all soft, yielding or unsuitable material shall be removed and backfilled with satisfactory material and again compacted thoroughly to 98% of dry density per ASTM D698 and finished to a smooth and unyielding surface.
- B. The finished grade shall be to the dimensions and design indicated on the Drawings or as directed by the Engineer for the bottom of the proposed construction.

3.3 CONCRETE CURB AND GUTTER CONSTRUCTION

- A. Construct curbs to lines and grade shown or established by the Engineer. Curbs shall match details of existing curb.
- B. Forming:
 - 1. Forms shall be straight, free from distortions, and shall show no vertical variation greater than 1/8-inch in 10 feet, and shall show no lateral variation greater than 1/8-inch in 10 feet from the true plane surface on the vertical face of the form.
 - 2. Forms shall be of the full depth of the structure and be so constructed as to permit the inside forms to be securely fastened to the outside forms.
 - 3. Securely hold forms in place true to the lines and grades.
 - 4. Wood forms may be used on sharp turns and for special sections as approved by the Engineer.
 - 5. Where wooden forms are used, they shall be free from warp and the nominal depth of the structure.
 - 6. All mortar and dirt shall be removed from forms and all forms shall be thoroughly oiled or wetted before any concrete is deposited.
 - 7. The supply of forms shall be sufficient to permit their remaining in place at least 12 hours after the concrete has been placed.
- C. Joints:
 - 1. Joints shall be constructed as indicated on the Drawings and as specified herein.
 - 2. Construct joints true to line with their faces perpendicular to the surface of the structure and within 1/4-inch of their designated position.
 - 3. Thoroughly spade and compact the concrete at the faces of all joints to fill all voids.
 - 4. Install expansion joint materials at the point of curve at all street returns.

5. Install expansion joint material behind the curb at abutment to sidewalks and adjacent structures.
6. Place contraction joints every 10 feet along the length of the curbs and gutters.
7. Form contraction joints using steel templates or division plates which conform to the cross section of the structure. Leave the templates in place until the concrete has set sufficiently to hold its shape, but remove them while the forms are still in place.
8. Contraction joint templates or plates shall not extend below the top of the steel reinforcement or shall be notched to permit the reinforcement to be continuous through the joint.
9. Contraction joints shall be a minimum of 1-1/2-inches deep.

D. Finishing:

1. Strike off the surface with a template, and finish the surface with a wood float using heavy pressure, after which, contraction joints shall be made and the surface finished with a wood float or steel trowel.
2. Finish the face of the curbs at the top and bottom with an approved finishing tool.
3. Finish edges with an approved finishing tool having a 1/4-inch radius.
4. Provide a final broom finish by lightly combing with a stiff broom after troweling is complete.
5. The finished surface shall not vary more than 1/8-inch in 10 feet from the established grade.

E. Concrete Curing:

1. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the structure shall be completely coated and sealed with a uniform layer of curing compound specified in Section 03055, Concrete.
2. The compound shall be applied in one or two applications as directed by the Engineer. When the compound is applied in two (2) increments, the second application shall follow the first application within 30 minutes.
3. The compound shall be applied continuously by means of an automatic self-propelled, pressure sprayer as approved by the Engineer at the rate directed by the Engineer, but not less than 1 gallon per 200 square feet of surface.
4. The equipment shall provide adequate stirring of the compound during application.
5. Should the method of applying the compound not produce uniform coverage, its use shall be discontinued, and the curing shall be by another method approved by the Engineer.

- F. Protection:
 - 1. Provide and use sufficient coverings for the protection of the concrete in case of rain or breakdown of curing equipment.
 - 2. Provide necessary barricades and lights to protect the work and rebuild or repair to the approval of the Engineer. All damage caused by people, vehicles, animals, rain, the Contractor's operations and the like shall be repaired by the Contractor at no additional expense to the City

3.4 REPLACEMENT OF CONCRETE CURB AND GUTTER

- A. When a section is removed, the existing curb and gutter shall be cut to a neat line, perpendicular to both the centerline and the surface of the concrete slab. Existing concrete shall be cut along the nearest existing construction joint.
- B. Existing concrete curbs and gutters that have been cut and removed for construction purposes shall be replaced with the same width and surface as the portion removed. The new work shall be neatly jointed to the existing concrete so that the surfaces of the new work shall form an even, unbroken plane with the existing surfaces.
- C. The subgrade shall be formed by excavating to a depth equal to the thickness of the concrete, plus 2-inches. Subgrade shall be of such width as to permit the proper installation and bracing of the forms. Subgrade shall be compacted by hand tamping or rolling. Soft, yielding or unstable material shall be removed and backfilled with satisfactory material. Place 2-inches of crushed stone under all curbs, and gutters and compact thoroughly, then finish to a smooth surface at proper line, grade, and cross-section.
- D. All work shall conform to the requirements for new curbs and gutters as detailed in this Section.

3.5 CLEANING

- A. All excess or unsuitable material shall be removed and disposed by the Contractor.
- B. All surfaces of the Work and adjacent surfaces shall be broom clean. Contractor shall use pressure washing and other means approved by the Engineer to remove splashed and spilled concrete from the Work and adjacent surfaces.
- C. Disturbed seeded areas shall be reseeded per requirements of Section 02933, Seeding and Sodding.

END OF SECTION

SECTION 02535

REINFORCED CONCRETE STORM DRAIN PIPE

PART 1 – GENERAL

1.1 SCOPE

The Contractor shall furnish all labor, materials, equipment and incidentals required to install all reinforced concrete storm drain pipe.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the Contract. In addition, the following specific information shall be provided to the City DWM as part of the Project record:
 - 1. Product Data: Descriptive details and shop drawings covering full details of pipe, fittings, specials, joints and the assembly thereof, joint materials and details thereof, and full details and cuts of all castings to be incorporated into the Work.
 - 2. Manufacturer's Installation Instructions: Special procedures required to install products specified.
 - 3. Manufacturer's Certificate: A manufacturer's certificate certifying that products meet or exceed specified requirements.
- B. Submit shop drawings to the City DWM showing a complete laying plan of all pipe, including all fittings, adapters, and specials along with the manufacturer's drawings and specifications indicating complete details of all items. The pipe details shall include stationing, pipe class or design and supporting computations; and laying schedule which specifies pipe class, class coding, pipe stationing for all changes in grade or horizontal alignment, transition stations for various pipe classes and the limits of each.

1.3 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards.
 - 1. ASTM C33 – Specification for Concrete Aggregate
 - 2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - 3. ASTM C150 – Standard Specifications for Portland Cement

4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes using Rubber gaskets
5. ASTM C655 – Standard Specifications for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
6. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
7. ASTM C1619 – Standard Specification for Elastomeric Seals for Joining Concrete Structures

1.4 TRANSPORTATION AND HANDLING

- A. Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.
- B. Handle pipe, fittings and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift or front loader. Do not use material damaged in handling.

1.5 STORAGE AND PROTECTION

- A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.
- B. Stored materials shall be kept safe from damage. The interior of all pipes, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall be stored per the manufacturer's recommendations.
- D. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

1.6 ACCEPTANCE

- A. Acceptance of pipe shall be on the basis of plant load-bearing tests of the pipe, material tests and inspection of manufactured pipe for visual defects and imperfections as described in paragraph 5.1.1 of ASTM C76.
- B. All pipe shall be manufactured in accordance with the American Concrete Pipe Association QCast Storm Sewer quality assurance program. If pipe producer is not QCast certified, each length of pipe shall be stamped by a regular employee of an approved testing agency.

- C. If producer is not QCast certified, provide results of tests on pipe, pipe materials, joint material, and made-up joints by an independent testing laboratory. Include materials, absorption, crushing and hydrostatic leakage tests on pipe of each size in accordance with applicable specifications.
- D. Inspect pipe after delivery for QCast or laboratory stamp, shape, cracks, uniformity, blisters and imperfect surfaces, hammer test, damaged ends and gasket grooves. Any pipe repaired or patched is subject to rejection if such repairs or patches are not sound and properly finished.
- E. Pipe shall not be shipped until it has attained full specified 28 day compressive strength.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All reinforced concrete storm drain pipe shall conform to the requirements ASTM C76, except as specifically extended, modified or amended in this section.
- B. All reinforced concrete storm drain pipe shall meet the standards for ASTM C76 Class III. All reinforced concrete storm drain pipe shall have a minimum of a B wall thickness.

2.2 CONCRETE PIPE

- A. Reinforced concrete storm drain pipe shall be manufactured in accordance with ASTM C76 and shall be furnished in not less than eight (8) foot lengths. Special pieces and closure pieces may be of shorter lengths than specified in this section. Pipe shall be manufactured wet cast, dry cast, or centrifugally cast.
- B. No lifting holes shall be provided in the wall of the pipe. Care shall be exercised in handling and transporting the pipe so as to protect the full interior wall of the pipe. No inward projecting hooks or lift bars shall be used in lifting pipe. Extreme care shall be applied to handling pipe immediately after manufacture to prevent development of "cure" cracks and stress cracks due to transporting pipe before full length of curing time.
- C. All reinforced concrete storm drain pipe shall be made with concrete with a twenty eight (28) day minimum compressive strength of 4000 psi and the absorption shall not exceed nine (9) percent. All cement and aggregate shall conform to the requirements of ASTM C76. Coarse aggregate shall meet the requirements of ASTM C33 of a size that provides a workable homogeneous, high quality concrete mixture, considering the particular wall thickness. Cement, for reinforced concrete pipe, shall be Type I/II Portland cement. The requirements of this article shall apply to all

reinforced concrete pipe manufactured under the requirements of ASTM C76 and ASTM C443.

- D. Reinforcement shall consist of either wire conforming to the standard specification for deformed steel wire for concrete reinforcement (ASTM A496), welded deformed steel wire fabric for concrete reinforcement (ASTM A497), bars of intermediate grade steel conforming to standard specifications for billet steel bars for concrete reinforcement (ASTM A615, Grade 60) or from fabricated deformed steel mats for concrete reinforcing (ASTM A184). Steel areas shall be in accordance with ASTM C76. Pipe with a diameter of 42-inches and larger shall be reinforced with two (2) full circular steel cages. Elliptical steel cages or quadrant steel cages shall not be allowed. Reinforcing steel shall be positioned in accordance with the clearances specified in ASTM C76. Clearance shall be provided for the full length of the pipe from bell end to spigot end of the pipe. Steel positioning shall not vary within the forms more than +/-10% of the wall thickness or +/-one-half (1/2)-inch, whichever is greater.
- E. Variations of the internal diameter of the pipe shall comply with paragraph 12.1 of ASTM C76. The planes of the ends of the pipe shall be perpendicular to the longitudinal axis of the pipe except as specified for beveled end pipe (special pieces below). The ends of the pipe shall be of such a design that the pipe, when laid, shall form a continuous conduit with smooth and uniform interior surface. Minor repairs to the pipe are allowed as outlined in accordance with ASTM C76. Minor repairs made at the point of manufacture or in the field shall be filled with a permanent non-shrinking patching compound. Mortar patching compound shall be similar and equal to Embeco 167 Mortar as manufactured by Master Builders, Thoropatch as manufactured by Thoroseal Products, or equal. The QCast Inspector shall inspect the lengths of pipe before they are shipped to the project site and shall require the manufacturer to apply the mortar as directed. No mortar shall be applied without prior approval of the QCast Inspector.
- F. A record of pipe supplied for the project shall be furnished to the City DWM by the manufacturer. All pipe shipped to the site of the Work shall be clearly marked as to type, date of manufacture, and name or trademark of manufacturer. The historical record of pipe supplied shall contain: class, date of manufacture, dates of inspection, date of shipment, and dates and results of compressive tests on cylinders and cores.
- G. The Contractor shall not unload the pipe from trucks at the site of the Work in a manner that might damage the pipe. It shall be the responsibility of the Contractor to assure that the pipe is manufactured, loaded, transported, unloaded, stored, and installed in a manner which does not result in damage to the pipe.
- H. The Contractor reserves the right to reject any and all pipe until it meets all the requirements of these specifications.

2.3 SPECIAL PIECES

Special pieces of pipe such as bends shall be manufactured from cut lengths of straight pipe, and shall have carry-over reinforcement across adjoining planes in accordance with industry standards.

2.4 JOINTS

All joints and gaskets shall meet the requirements of ASTM C443.

2.5 SPECIAL DESIGN PIPE

- A. Special designs of reinforced concrete pipe shall be in accordance with the requirements of ASTM C76 Section 7.2 - modified or special designs.
- B. The pipe manufacturer shall not manufacture reinforced concrete pipe, test pipe, or produce pipe until approval has been obtained from the Contractor in writing. The manufacture of pipe shall have concrete cover over the inside steel cage and cover over the outside steel cage, in accordance to ASTM C76 standards, shall provide two complete circular mats of steel, and shall provide the strengths of steel as specified in this section. Pipe shall be designed per applicable sections of ASTM C76.
- C. The pipe manufacturer shall be required upon receiving the order from the Contractor to submit to the Contractor and City DWM as part of the project record, the design for the classes of pipe to be manufactured. Manufacturing drawings shall be required for each pipe size and pipe class. The drawings shall be working drawings to reflect sizes of steel (circumferential, longitudinal, spacer, and stirrups steel) as well as steel placement.
- D. Submission of certified three-edge-bearing tests already made may be considered as verification of Special Design in lieu of D-Load tests.
- E. The City DWM may select at random two full length joints of each class or size of pipe to be tested to D-loads that would produce applicable (ASTM C76) cracking. Tests shall be in accordance with applicable sections of ASTM C76 or as amended in this section. The test shall be performed in the presence of the QCast inspector.

PART 3 – EXECUTION

3.1 LAYING CONCRETE PIPE

- A. Excavation for the pipe and preparation of the trench bottom, including bedding to receive the pipe, shall be done in accordance with the requirements of Section 02225. In the preparation of the pipe bedding, the Contractor shall take into consideration any variation in thickness of the pipe wall, and the bed must be prepared to suit the particular piece of pipe to be lowered into place. Preparation of the compacted bed

shall be such that when the pipe is lowered in place and pulled to secure full compressive pack of the rubber joint ring, a smooth and uniform flow line on the specified grades will be secured. An interior inspection of the sewer will be made after sufficient time has elapsed for the backfill to attain its settlement in the trench.

- B. The pipe interior and joints shall be clean when lowered in the trench and shall be kept clean thereafter. The exposed ends of pipe in the trench shall be closed by suitable bulkheads at all times when pipe laying is not in progress. Each section of pipe shall be securely anchored in place before the next adjoining pipe is laid and the joint between the sections is made.
- C. No tools or equipment shall be used in the laying of the pipe that will damage the pipe. The trenching equipment shall not be used to force a joint of pipe into its proper position on grade by application of pressure on top of the pipe along its partial or full length. All pipe joints shall be brought home by use of properly designed equipment for the specific purpose in accordance with industry standards. Pipe lengths that have received damage to wall, spigot, or socket shall be replaced or repaired to the satisfaction of the Contractor. Such replacement or repair shall be at the Contractor's expense.
- D. The Contractor shall secure the following results with the pipe and joint used:
 - 1. A tight joint with gasket fully compressed and joint openings completely filled.
 - 2. Pipeline shall have a smooth and uniform interior section free from cracks, pits, voids, or crazing as defined in Sections 13 and 15 of ASTM C76. Longitudinal and transverse cracks with a width less than 0.01-inch shall be considered hairline and minor. Seal longitudinal and transverse cracks having a width equal to or greater than 0.01-inch and less than 0.10-inch if there is displacement across the crack and the soil pH is less than 5.5. Replace pipes having longitudinal and transverse cracks greater than 0.10-inch.
- E. Backfilling shall be in accordance with the requirements of Section 02225.

3.2 CLEANING

At the conclusion of the work, the Contractor shall clean all pipe by flushing with water or other means to remove all dirt, stone wood or other materials which may have entered the pipe during construction.

3.3 TESTING

Additional testing and inspection required for acceptability of installed storm sewers is specified in Section 02650.

3.4 CLEANUP

After completing each section of storm drain, the Contractor shall remove all debris and construction materials and equipment from the site of the Work; grade and smooth over the surface on both sides of the line; and leave the entire construction area in a clean and neat condition. The Contractor shall restore the site of the Work to its original or better condition.

+ + + END OF SECTION 02535 + + +

SECTION 02575

REMOVING AND REPLACING PAVEMENT

PART 1 - GENERAL

1.1 SCOPE

- A. The work to be performed under this Section shall consist of existing pavement, sidewalks, steps, patios, curbs, and gutters in paved areas where such have been removed for construction of utilities and appurtenances.
- B. Existing pavement, sidewalks, curbs, and gutters shall be replaced to meet the current City of Atlanta standards, or to match existing pavement sidewalk, curb, or gutters; whichever is more stringent.

1.2 SUBMITTALS

If required by the City or Engineer, provide certificates stating that materials supplied comply with Specifications. Certificates shall be signed by the asphalt producer and the Contractor.

1.3 CONDITIONS

- A. Weather Limitations:
 - 1. Apply bituminous tack coat only when the ambient temperature in the shade has been at least 50 degrees F for 12 hours immediately prior to application.
 - 2. Do not conduct paving operations when surface is wet or contains excess of moisture that would prevent uniform distribution and required penetration.
 - 3. Construct asphaltic courses only when atmospheric temperature in the shade is above 40 degrees F, when the underlying base is dry and when weather is not rainy.
 - 4. Place base course when air temperature is above 35 degrees F and rising.
- B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

- A. Graded Aggregate Base: The sub-base shall be a minimum of 6-inches thick and a width equal to the width of the finished paving. Aggregate base shall be Class A, meeting the requirements of the Georgia

Department of Transportation Specification Section 815.01. Compact to at least 95% Standard Proctor Density. (ASTM D-698)

- B. Base: The base for all paved roadways shall conform to the requirements of the Georgia Department of Transportation Specifications for the Hot Mix asphalt Section 828 Type “B”.
- C. Tack Coat: Tack coat shall conform to Section 413 of the Georgia Department of Transportation Standard Specifications.
- D. Binder Course: The binder course of all paved roadways shall conform to the requirements of Section 400, Type “B” of the Georgia Department of Transportation Standard Specifications.
- E. Surface Course: The surface course for all pavement, including prime or tack coat when required by the Engineer, shall conform to the requirements of Section 400, Type “E” of the Georgia Department of Transportation Standard Specifications
- F. Concrete: Provide concrete and reinforcing for concrete pavement or base courses in accordance with the requirements of the Georgia Department of Transportation Standard Specifications, Section 430. Concrete shall be minimum 3,000 psi compressive strength or as otherwise shown on the Drawings.
- G. Special Surfaces: Where pavement, sidewalks, steps, patios, curbs, or gutters are disturbed or damaged which are constructed of specialty type surfaces, e.g., brick or stone, these facilities shall be restored utilizing similar, if not original, materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

2.2 TYPES OF PAVEMENTS

- A. General: All existing pavement removed, destroyed or damaged by construction shall be replaced with the same type and thickness of pavement as that existed prior to construction, unless otherwise directed by the Engineer/Owner. Materials, equipment and construction methods used for paving work shall conform to the Georgia Department of Transportation specifications applicable to the particular type required for replacement, repair, or new pavements.
- B. Aggregate Base: Aggregate base shall be constructed in accordance with the requirements of Section 310 of the Georgia Department of Transportation Standard Specifications. The maximum thickness to be laid in a single course shall be 6 inches compacted. If the design thickness of the base is more than 6 inches, it shall be constructed in two or more

courses of approximate equal thickness. After the material placed has been shaped to line, grade, and cross section, it shall be rolled until the course has been uniformly compacted to at least 100 percent of the maximum dry density when Group 2 aggregate is used, or to at least 98 percent of maximum dry density when Group 1 aggregate is used.

- C. Concrete Pavement: Concrete pavement or base courses shall be replaced with concrete. The surface finish of the replaced concrete pavement shall conform to that of the existing pavement. The surface of the replaced concrete base course shall be left rough. The slab depth shall be as indicated in the plans, but in no case less than 6 inches thick. Transverse and longitudinal joints removed from concrete pavement shall be replaced as shown in the construction plans. Concrete pavements or concrete base courses shall be reinforced.
- D. Asphaltic Concrete Base, Bituminous Tack Coat, Binder, and Surface Course: Asphaltic concrete base, tack coat, and surface course construction shall conform to Georgia Department of Transportation Standard Specifications, Section 400. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared; surface is intact, firm, properly cured, dry; and the tack coat has been applied. Apply and compact the base in maximum layer thickness by asphalt spreader equipment of design and operation approved by the Engineer/Owner. After compaction, the black base shall be smooth and true to established profiles and sections. Apply and compact the surface course in a manner approved by the Engineer/Owner. Immediately correct any high, low, or defective areas by cutting out the course, replacing with fresh hot mix, and immediately compacting to conform and thoroughly bond to the surrounding area.
- E. Surface Treatment Pavement: Bituminous penetration surface treatment pavement shall be replaced with a minimum thickness of 1 inch conforming to Section 424, Georgia Department of Transportation Standard Specifications.
- F. Gravel Surfaces: Existing gravel road, drive, and parking area replacement shall meet the requirements of graded aggregate base course. This surfacing may be authorized by the Engineer/Owner as a temporary surface for paved streets until replacement of hard surfaced pavement is authorized.
- G. Temporary Measures: During the period between pavement removal and complete replacement of permanent pavement, maintain highways, streets, and roadways by the use of steel running plates anchored to prevent movement. The backfill above the pipe shall be compacted, as specified in Section 02200/02225 of these Specifications, up to the existing

pavement surface to provide support for the steel running plates. All pavements shall be replaced within seven calendar days of their removal.

PART 3 - EXECUTION

3.1 LOCATIONS FOR PAVEMENT REPLACEMENT

- A. Pavement Replacement:
 - 1. All trenches for roadway crossings
 - 2. All trench longitudinal installations
 - 3. All locations where pavement must be removed or is damaged in the execution of the Work
- B. "Graded Aggregate" pavement repair shall be used only where approved by the Engineer/Owner.

3.2 REMOVING PAVEMENT

- A. General: Remove existing pavement as necessary for installing the pipeline and appurtenances. Existing pavement and sub-base shall be removed for trench construction and pipe installation. Existing pavement on either side of the trench construction area shall be completely milled from edge of pavement to edge of pavement in order to replace pavement from edge of pavement to edge of pavement for all disturbed paved areas.
- B. Remove and replace pavement and base to outer edge of existing pavement if existing pavement width is 24-inches or less from side of trench to outer edge of pavement.
- C. Marking: Before removing any pavement, mark the pavement neatly paralleling pipelines and existing street lines. Space the marks the width of the trench
- D. Saw Cutting: Under no circumstances shall the Contractor be allowed to remove concrete or asphalt without prior saw cutting. Asphalt pavement shall be saw cut along the marks using suitable equipment. The saw cutting shall be deep enough to produce an even, straight cut.
- E. Breaking: Break asphalt pavement along the marks using pavement shearing equipment, jack hammers or other suitable tools. Break concrete pavement along the marks by scoring with a rotary saw and breaking below the score by the use of jack hammers or other suitable tools.
- F. Machine Pulling: Do not pull pavement with machines until the pavement is completely broken and separated from pavement to remain.

- G. Damage to Adjacent Pavement: Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.
- H. Sidewalks and Patios: Remove and replace any sidewalks or patios disturbed by construction for their full width and to the nearest undisturbed joint.
- I. Curbs and Gutters: Tunnel under or remove and replace any curb and/or gutter, which is disturbed by construction to the nearest undisturbed joint.
- J. Steps: Completely remove and replace any steps, constructed of concrete or special surfaces, which are disturbed by construction.

3.3 REPLACING PAVEMENT

- A. Preparation of Subgrade: Upon completion of backfilling and compaction of the backfill, arrange to have the compaction tested by an independent testing laboratory approved by the Engineer/Owner. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks, and curbs removed.
 - 1. The existing street pavement or surface shall be removed or milled along the lines of the work from edge of pavement to edge of pavement. Pavement shall be replaced from edge of existing pavement to edge of existing pavement.
 - 2. Trench backfill shall be compacted for the full depth of the trench as specified in Section 02200/02225 of these Specifications.
 - 3. Temporary trench backfill along streets and driveways shall include 6 inches of crushed stone or cherty clay as a temporary surfacing of the trenches. This temporary surface shall be maintained carefully at grade, dust free, by the Contractor until the backfill of the trench has thoroughly compacted in the opinion of the Engineer/Owner, and permission is granted to replace the street pavement.
 - 4. When temporary crushed stone or chert surface is considered by the Engineer/Owner to be sufficient surface for gravel pavement, the surface shall be graded smooth and to an elevation that will make the final permanent surfacing level with the adjacent surfacing that was undisturbed.
- B. Pavement Replacement:
 - 1. Prior to replacing pavement, make a final cut in concrete pavement 12 inches back from the edge of the damaged pavement with a concrete saw. Remove asphalt pavement 12 inches back from the edge of the damaged pavement using pavement shearing equipment, jackhammers or other suitable tools.

2. Replace and repave all street and roadway pavement from edge of pavement to edge of pavement as shown on the Drawings; as shown on the details contained herein. Replace driveways, sidewalks, and curbs with the same material, to nearest existing undisturbed construction joint and to the same dimensions as those existing.
3. If the temporary crushed stone or chert surface is to be replaced, the top 6 inches shall be removed and the crushed stone surfacing for unpaved streets or the base for the bituminous surface shall be placed.
4. Following this preparation, the chert or crushed stone base shall be primed with a suitable bituminous material and surfaced with the proper type of bituminous surface treatment.
5. Where the paved surface is to be replaced with asphaltic concrete pavement, concrete pavement or with a concrete base and a surface course, the temporary chert or crushed stone surface and any necessary backfill material, additional existing paving and new excavation shall be removed to the depth and width shown on the Drawings/details. All edges of the existing pavement shall be cut to a straight, vertical edge. Care shall be used to get a smooth joint between the old and new pavement and to produce an even surface on the completed street. Concrete base slabs and crushed stone bases, if required, shall be placed and allowed to cure for three days before bituminous concrete surface courses are applied. Expansion joints, where applicable, shall be replaced in a manner equal to the original joint.
6. Where driveways or roadways, constructed of specialty type surfaces, e.g., brick or stone are disturbed or damaged, these driveways and roadways shall be restored utilizing similar materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

C. Pavement Resurfacing:

1. After all pipe line installations are complete and existing pavement has been removed or milled from edge of pavement to edge of pavement, apply tack coat and surface course as specified.
2. Resurfacing limits shall be perpendicular to the road centerline. The limits of resurfacing shall be 10 feet beyond the edge of the pavement replacement on the main road being resurfaced.
3. Where pavement damaged with potholes, the Contractor shall remove all existing loose pavement material and fill the hole with black base, as specified, to the level of the existing pavement.

- D. Pavement Striping: Pavement striping removed or paved over shall be replaced with the same type, dimension, and material as original unless directed otherwise by the Engineer/Owner.
- E. Installation of Traffic Plates: Following completion of sewer works including backfilling but prior to replacement of pavement, steel plates shall be used to temporarily carry vehicular traffic as follows:
 - 1. All Steel plates shall meet ASTM structural specifications having “A36” designation with minimum yield stress of 36 ksi (ksi = kilopounds per square inch).
 - 2. Asphaltic patching material (cold mix) shall be used to secure the steel plate around its edges. Alternatively, all sides of the plate or plates must be secured to the ground surface with A.R.E.A. standard railroad spikes. No spikes shall be left lying on the highway.
 - 3. Trench must be backfilled to within eight (8) inches from top of existing pavement prior to placing the steel plate.
 - 4. No plate is allowed over a trench having a width greater than 48 inches when adequate soil conditions are present. When the trench is greater than 48 inches, the entire lane containing the trench shall be closed. Before closing a lane, a “Lane Closure Permit” must be obtained from the City of Atlanta, Department of Public Works, Bureau of Traffic and Transportation. At least 24 hours prior notification is required for the “Lane Closure Permit”.
 - 5. All necessary warning signs, barricades, and lights shall be adequately provided and placed for the safety of the public and in full conformity with the MUTCD at no additional cost to the City. Before closing a “Lane Closure Permit” must be obtained from the City of Atlanta. The Department of Public Works, Bureau of Traffic and Transportation must be notified at least 24 hours in advance.
 - 6. The width of a trench is measured normal to the length of the trench. The largest reading of the measurements is the determining factor for width. For a series of steel plates on any continuous trench, all plates must have the same thickness.
 - 7. Trench must be fully covered with a minimum of twelve (12) inches of asphalt taper on all sides of the plate.
 - 8. Upon the completion of the work, the existing surface shall be cleaned and pavement restored to the City of Atlanta standards.

3.4 CONCRETE CURB AND GUTTER REPLACEMENT

Conform with requirements of Section 02521, Sidewalk, Curb, and Gutter.

3.5 MAINTENANCE

The Contractor shall maintain the surfaces of roadways built and pavements replaced until the acceptance of the Project. Maintenance shall include replacement, scraping, reshaping, wetting, and re-rolling as necessary to prevent raveling of the road material, the preservation of reasonably smooth surfaces and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Engineer. Maintenance shall include sprinkling as may be necessary to abate dust from the gravel surfaces.

3.6 SUPERVISION AND APPROVAL

- A. Pavement restoration shall meet the requirements of the regulatory agency responsible for the pavement. Obtain agency approval of pavement restorations before requesting final payment.
- B. Obtain the Engineer's/Owner's approval of restoration of pavement, such as private roads and drives that are not the responsibility of a regulatory agency.
- C. Complete pavement restoration as soon as possible after backfilling.
- D. Failure of Pavement: Should any pavement restoration or repairs fail or settle during the life of the Contract, including the bonded period, promptly restore or repair defects.
- E. Prior to acceptance and approval of any asphaltic concrete binder and/or topping which is installed for the purpose of City maintenance, a representative of the City of Atlanta's Department of Traffic and Transportation may require one or all of the following tests: 1) coring, 2) extraction, 3) compaction, 4) density. The frequency and location of these tests will be left up to the discretion of the Inspector/Engineer.

3.7 CLEANING

The Contractor shall remove all surplus excavation materials and debris from the street surfaces and rights-of-way and shall restore street, roadway, or sidewalk surfacing to its original condition.

END OF SECTION

SECTION 02600

WASTEWATER FLOW CONTROL

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install all labor, materials, equipment and incidentals required to bypass all existing wastewater flows encountered in conjunction with the removal, abandonment, and/or isolation of facilities being modified by this Project.
- B. All flow shall be pumped around the pump station and sewer segments during the installation and testing of the new or modified pump station, new sewer, sewer connections/reconnections, the replacement of manholes and force main modifications.
- C. Contractor shall be responsible for all sewage pumping and any overflows or spills that may occur for any reason including, but not limited to, equipment failure, clogging, hose or pipe breakage, or high flows.
- D. Make available a 100% redundant pumping system on-site and ready to place into service should the primary system fail to function as required.
- E. Provide 24-hours per day, seven day per week manned operation of the bypass pumping system when in operation.
- F. The Contractor shall include the installation of an auto dialer in the bypass pumping system and a lock box for the pump controls and float levels. Auto dialers shall have the ability to connect to a minimum of two of the Contractor's staff and the City DWM when a failure/power outage occurs.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the Contract. In addition, the following specific information shall be provided to the City DWM as part of the Project record:
 - 1. The design, installation, and operation of the wastewater flow control system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor that specializes in the design and operation of wastewater flow control systems. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
 - 2. The Contractor shall prepare a wastewater flow control plan and submit it to the City DWM prior to diverting any flow. The wastewater flow control plan shall include the make and model of temporary bypass pumps, the certified noise levels of the

pumps and generator, the means used to maintain and operate the bypass pumps, and a written statement that all bypass pumping shall comply with the requirements of these Specifications and any local codes and ordinances.

3. The wastewater flow control plan shall be submitted to the City DWM at least thirty (30) days before any planned diversion. The plan shall outline all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. The plan shall be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to insure adequate wastewater control. The plan shall also include details of protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Specifications. No construction shall begin until all provisions and requirements have been reviewed and accepted by the City DWM.
4. The Contractor shall submit the wastewater flow control plan for each sewer bypass set-up with detail including the following:
 - a. Staging areas for pumps.
 - b. Sewer plugging method and types of plugs. Double plugs are recommended.
 - c. Number, size, material, location, and method of installation of suction piping.
 - d. Bypass pump sizes, capacity, number of each size to be on the Work site and power requirements.
 - e. Calculations of static lift, friction losses, and flow velocity (pump curves) showing pump operating range.
 - f. Standby power generator size and location.
 - g. Downstream piping and discharge plan.
 - h. Method of protecting discharge manholes or structures from erosion and damage.
 - i. Thrust and restraint block sizes and locations.
 - j. Sections showing suction and discharge pipe depth, embedment, select fill, and special backfill where required.
 - k. Certified decibel levels of individual pumps, the combined decibel level if multiple pumps will be operated simultaneously and the method of noise control for each pump and/or generator.
 - l. Any temporary pipe supports, including rollers and elevated rollers, as well as anchoring required.
 - m. Design plans and computations for access to bypass pumping locations.
 - n. Calculations for selection of bypass pumping pipe size.
 - o. Schedule for installation and maintenance of bypass pumping lines.
 - p. Plan indicating location of bypass pumping line.
 - q. The Plan shall indicate the means by which flows from laterals are provided for either by plugging, containing, or subsidiary pumping. Building laterals shall not be disconnected or plugged overnight. Plugging of laterals is only allowed from 9 a.m. until 5 p.m. of the same day.
 - r. Pump security including lockable cover over switches so pumps cannot be

- disabled by others.
- s. Emergency action plan identifying the measures taken in the event of a pump failure.
 - t. Staffing plan for responding to alarm conditions identifying multiple contacts by name and phone numbers (office, mobile, etc.).
 - w. A contingency plan to implement in the event the repair, rehabilitation, and/or replacement work has unexpected delays or problems.
 - x. A schedule of how long the bypass system is to be in operation to allow the repair, rehabilitation, and/or replacement work.
 - y. Project specific shutdown activities checklist.
- 5. Any proposal to implement wastewater flow control arrangements on sewers, including plugging and/or blocking, high-velocity nozzles, and/or bypass and/or diversion pumping as well as any sewer repair replacement construction, shall be outlined in writing and submitted to the City DWM at least thirty (30) days prior to the implementation of the wastewater flow control system, sewer repair or replacement.
 - 6. All proposed wastewater flow control arrangements, including flow bypass and/or diversion plans, shall indicate or show the location and position, as necessary, of any special features where pipes or hoses cross roadways, including intersections, such as temporary trenches, support bridges, ramp-overs, etc.
 - 7. All proposed wastewater flow control arrangements, including wastewater flow bypass and/or diversion pumping plans for sewers, shall also include an emergency response plan to be followed in the event of a failure of the wastewater flow control system. The Contractor shall provide names and phone numbers for twenty-four (24) hour emergency contact. Provide cell phone type auto-dialers for unattended operations.
 - 8. The Contractor shall notify the City DWM forty-eight (48) hours prior to commencing actual wastewater flow control operations. The Contractor's Wastewater Flow Control Plan shall be approved by the City DWM before the Contractor shall be allowed to commence wastewater flow control work.

1.03 GENERAL

A. The objective of wastewater flow control is to:

- 1. Maintain an uninterrupted level of service to wastewater collection system users while maintenance or construction operations are occurring on the segment or segments being bypassed and/or from which flow is being diverted, within the wastewater collection system.
- 2. Ensure that wastewater flow is continuously handled around the segment or segments of sewer being bypassed and/or from which flow is being diverted by:

- a. Ensuring that bypass and diversion pumps are adequately fueled, lubricated and maintained.
- b. Ensuring backup pumping redundancy and spare parts are readily available for the flow bypass and/or diversion pumping system in the event of component breakdown.
- c. Ensuring that an emergency backup plan is implemented in the event of system failure.
- d. Preventing backup, spillage, flooding or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways, while flow bypass or diversion pumping takes place and ensuring that installation, startup and subsequent disassembly of the flow bypass and diversion pumping system is transitioned.

B. Pre-installation Meetings

- 1. Prior to beginning bypass pumping operations, schedule and conduct a pre-startup meeting. Items to be covered include, but are not limited to the following:
 - a. Testing of bypass pumping equipment to verify satisfactory operation, as described below.
 - b. Testing of alarm status notification system.
 - c. Coordination with the City DWM operations personnel to ensure suitable access is provided to facilities which will remain in operation.
 - d. Verification of noise levels around pumping equipment.
 - e. Identification of lowest overflow location within system and maximum water surface elevation in suction manhole.
- 2. Utilize Bypass Pump System Start-up Checklist (sample attached at end of section), for starting and shutting down bypass pump system. Obtain the City DWM approval on Checklist prior to starting or shutting down the bypass pump system.

C. Coordination

- 1. Bypass pumping shall be monitored by the Contractor or bypass system supplier personnel at all times. If pumping operation continues past normal working hours, monitor the pumps 24 hours a day, seven days per week on site as long as the operation is in place.
- 2. Provide an automatic notification system (similar to a RACO type system) to notify the Contractor and the City DWM of a pump failure or high water level in the suction manhole. Respond to any alarm condition within five (5) minutes of notification. All costs incurred due to alarm conditions will be the responsibility of the Contractor.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Suppliers

- a. Utilize bypass pumping system suppliers who have a minimum of five (5) years of experience providing bypass pumps for similar situations.
- b. Provide field service personnel who can respond to an emergency or alarm condition within one (1) hour of notification.
- c. Provide quality equipment and accessories (hoses, clamps etc.) with no leaks or damage visible.
- d. Demonstrate equipment provided is of good quality and in good working order.
- e. Keep and maintain bypass pumping redundancy and spare parts for pumps and piping on-site, as required.
- f. Provide quality workmanship in setting up the bypass pumping system.

1.05 REGULATORY REQUIREMENTS

- A. The work of this section shall comply with the current versions, with revisions, of OSHA 29 CFR 1910.146 (permit-required confined-space regulations).
- B. All Work and testing shall comply with the applicable Federal codes, including Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended, and applicable state and local codes and standards; and to the extent applicable with the requirements of the Underwriter's Laboratories, Inc. and the National Electric Code.
- C. The Contractor is responsible for acquiring any necessary environmental, Federal, State, Local, Georgia DOT and any other permits necessary for bypass pumping. Provide the City DWM a detailed schedule and plan regarding any temporary street and/or road closures a minimum of thirty days prior to any construction activities.

1.06 FIELD CONDITIONS

- A. Existing Conditions
 1. It is the Contractor's and pump supplier's responsibility to verify the available working area for the bypass pumping system, the hydraulic conditions for the pumping system, and suitable locations for suction and discharge piping.
 2. It is the Contractor's responsibility to protect the environment around the bypass system and ensure no damage occurs.

PART 2 PRODUCTS

2.01 PIPE FOR FLOW DIVERSION

- A. Ductile Iron Pipe: Ductile iron pipe as specified in Section 15060 is acceptable for use for flow diversion during construction.

- B. Polyethylene Pipe: Polyethylene material shall comply with the requirements for Type III polyethylene, C-5 and P-34 as tabulated in ASTM D1248 and have the Plastic Pipe Institute recommended designation PE3406. The material shall also have an average specific base resin density of between 0.94 g/cc and 0.955 g/cc (ASTM D1505). Pipe made from these resins must have a long term strength (50 years) rating of 1,250 psi or more per hydrostatic design basis categories of ASTM D2837. The polyethylene resin shall contain antioxidants and be stabilized against ultraviolet degradation to provide protection during processing and subsequent weather exposure. The polyethylene resin shall have an environmental stress crack resistance, condition C as shown in ASTM D1693, to be greater than five-hundred (500) hours, twenty (20) percent failure. All pipe shall be made from virgin quality material. No rework compound, except that obtained from the manufacturer's own production of the same formulation shall be used. The polyethylene resin shall have an average melt flow index, condition E as shown in ASTM D1238, not in excess of 0.25 g/10 min. Pipe shall be homogeneous throughout, and free of visible cracks, holes, foreign material, blisters, or other deleterious faults. Diameters and wall thickness shall be measured in accordance with the requirements of ASTM D2122. Pipe joining will be done by thermal butt fusion method in accordance with the requirements of ASTM D657.
- C. Pipes do not have to be new but must be free of defects.
- D. Suitably brace the discharge piping in the manhole and direct the discharge so that damage to existing facilities and equipment is prevented. If multiple pumps are required to meet the required pumping capacities, provide the necessary fittings and connections for connecting multiple pump discharges to a single discharge pipe. Provide piping of suitable size and material to handle the flow and pressure of the pumping system, as determined in approved system engineering calculations.
- E. Provide, on-site, spare suction and discharge piping, fittings, valves, gaskets, etc. ready to be used if there is a failure within the system.
- F. Piping shall be hydrostatic tested in excess of operating pressure prior to pumping any wastewater.

2.02 PUMPING EQUIPMENT

- A. Provide pumping equipment with the capacity to convey 100% of peak flows around the construction area. All pumps used shall be fully automatic self-priming units that do not require the use of foot valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. For diesel powered systems, provide a minimum fuel storage capacity for 48 hours of continuous operation. Provide all of the required diesel fuel for the system. For electric powered systems, provide the required electrical power to operate the system. All pumps used shall be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.
- B. All pumps (and generators if used) shall be fully sound attenuated and shall not produce a

noise level in excess of the applicable local codes/ordinances.

- C. The Contractor shall provide the necessary stop/start controls for each pump.
- D. The Contractor shall include one stand-by pump of each size to be maintained on site of the Work. Back-up pumps shall be on-line, isolated from the primary system by a valve.
- E. The Contractor shall design all piping, joints, and accessories to withstand twice the maximum system pressure or fifty (50) psi, whichever is greater. The back-up pump, appropriate piping, fuel, lubrication, and spare parts shall be incorporated into the bypass arrangement at the site of the Work, ready for use in case of breakdown. A bypass “drill” shall be carried out by the City DWM before the bypass arrangement is accepted on all sewers greater than twelve (12) inches in diameter, at no cost to the City DWM. The drill shall demonstrate the incorporation of all standby equipment to handle flows when the main pump set is switched off. The City DWM’s instructions following the drill shall be adhered to in full at no cost to the City DWM.
- F. No more than two (2) pump discharge hoses shall be used for wastewater flow control over a length of the line segment(s). If the flow exceeds the capacity of two (2) hoses then rigid piping shall be used. The rigid piping shall consist of ductile iron pipe, HDPE, or steel pipes with suitable pressure rated couplings to withstand twice the maximum system pressure or fifty (50) psi, whichever is greater.
- G. Under no circumstances will aluminum “irrigation” type piping or glued PVC pipe be allowed. Discharge hose will only be allowed in short sections and by specific permission from the Engineer.
- H. Equip the pumping system with the necessary float switches or level monitoring devices required for starting and stopping the pump. Also provide float switches to sound an alarm if the water level in the bypass pumping system wet well reaches a critical depth.
- I. Discharge flow into a bypass connection on the existing force main, thus bypassing the pump station and/or sewer segment(s) under construction.
- J. Provide spill and leak containment under the pumping equipment or install a berm around the equipment to prevent leaks, drips, or blow-offs from contaminating the site.

2.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. The estimated flows to be bypassed are in Specification 01014 Work Sequence under Part 1-GENERAL, Section 1.1 SCOPE. Contractor shall confirm these flows as part of developing the wastewater flow control plan.
 - 2. The Contractor shall provide all pipeline plugs, pumps, and temporary discharge

pipings to ensure that the total mainline flow is diverted around the section on which work is being done.

3. Wastewater flow control system will be required to be operated twenty-four (24) hours per day.
4. The Contractor shall have adequate standby equipment available and ready for operation and use in the event of an emergency or breakdown. One (1) standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure. Make available a 100% redundant pumping system on-site and ready to place into service should the primary system fail to function as required.
5. The wastewater flow control system shall be capable of bypassing the flow around the work area and of releasing any amount of flow, up to full available flow, into the work area as necessary for satisfactory performance of the Work.
6. Provide the necessary hoisting equipment for each pump on-site throughout bypass pumping system operation.

B. Performance Requirements:

1. The Contractor shall provide, maintain, and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the wastewater flow before it reaches the point where it would interfere with the Work, carry it past the Work, and return it to the existing sewer downstream of the work.
2. The Contractor shall provide all necessary means to safely convey the wastewater past the work area. The contractor will not be permitted to stop or impede the mainline flows under any circumstances.
3. The Contractor shall maintain wastewater flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers, and that will protect public and private property from damage and flooding.
4. The Contractor shall protect water resources, wetlands, and other natural resources. Provide spill and leak containment under the pumping equipment or install a berm around the equipment to prevent leaks, drips, or blow-offs from contaminating the site.

PART 3 EXECUTION

3.01 PLANNING

- A. The Contractor shall be solely responsible for planning and executing all wastewater flow control operations. The Contractor shall be entirely liable for damages to private or public property that may result from his operations and for all cleanup, disinfection, damages, and resultant fines in the event of a spillage, flooding, or overflow.
- B. Complete the Bypass Pump System Start-up Checklist (attached) and obtain the required signatures prior to shutting down any operating pump station. Develop a project specific shutdown checklist describing the steps to be taken for the following phases:
 - 1. Prior to shutting down the pump station.
 - 2. During the pump station shutdown.
 - 3. Returning the pump station back to service.
- C. Bypass the wet well, valve vault, or portion of sewer under construction, as necessary, for the repair, replacement, or rehabilitation of the existing facilities.
- D. Prior to plugging flow through the existing facilities, demonstrate that the entire bypass pumping system is functioning as required to the City DWM's satisfaction. Demonstrate satisfactory operation of the bypass pumping system by conducting a system test lasting a minimum of six (6) hours, where a portion of the test period is during a peak daily flow period. Start the bypass system test no later than 7:30 AM to ensure an overlap with peak flow period. If the test is not started by this time, it will be postponed until the next day. Bypass system testing may not be conducted on Fridays.

3.02 GENERAL

- A. All materials used for wastewater flow control shall be industry standard and as specified herein.
- B. The Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbances to existing utilities. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
- C. During all wastewater flow control operations, the Contractor shall protect mainlines, manholes, and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to mainlines, manholes, and all local sewer lines caused by human or mechanical failure.
- D.
- E.
- F. Wastewater flow diversion controls must keep the wastewater flowing without discharge or spills.
- G. The Contractor shall seek and obtain inspection of each newly completed facility before

taking the bypass out of service.

- H. When pumps are operating, a maintenance operator, mechanic and/or assistant shall continuously be on site to monitor the operation of the entire bypass/diversion system. The operator, mechanic and/or assistant shall:
1. Adjust pump speed as appropriate so as not to adversely impact upstream or downstream flow condition levels.
 2. Check that the bulkheads, dams, diaphragms, plugs, valves, weirs, and all other flow control devices are working effectively.
 3. Check the integrity of hoses and couplings along the entire bypass/diversion system.
 4. Monitor fuel tanks and top off as appropriate.
 5. Monitor lubrication levels and top off as necessary.
 6. Facilitate minor repairs as required.
 7. Report on potential problems arising.
 8. Inspect bypass-pumping system at least hourly to ensure that the system is working correctly.
 9. Maintain 100% redundant pumping capacity and adequate supply of spare parts on site as required.

3.03 PUMPING AND BYPASSING

- A. When bypass pumping is required, a pump size shall be selected by the Contractor. The Contractor shall supply the necessary pumps, conduits, and other equipment to divert the flow of wastewater around the manhole section in which the Work is to be performed. The bypass system shall be of sufficient capacity to handle existing flows plus additional flow that may occur during periods of rainstorms. The Contractor shall be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. A "setup" consists of the necessary pumps, conduits, and other equipment required to divert the flow of wastewater around a manhole to manhole section, from the start to finish of work performed in the manhole to manhole section.
- B. Wastewater shall be pumped directly into the nearest available downstream manhole. The Contractor shall be responsible for keeping the pumps running continuously twenty four (24) hours a day if required, until the bypass operation is no longer required. The Contractor shall have standby pumps at all times.
- C. Contractor shall secure discharge hose/piping into downstream manhole to prevent spills.

3.04 FLOW CONTROL PRECAUTIONS

- A. Where the wastewater flow is blocked or plugged, the Contractor shall be responsible for taking sufficient precautions to protect public health. The sewer lines shall also be protected from damage. The following shall apply:
 - 1. No wastewater shall be allowed to back up into any homes or buildings.
 - 2. No wastewater shall overflow any manholes, cleanouts, or any other access to the sewers.
 - 3. No interruption of water and sewer utilities users upstream of the inspection/repair area shall be allowed to occur.
 - 4. If any of the above occur or are expected to occur, the Contractor shall provide bypass pumping to alleviate all of the conditions. Additionally, the Contractor shall observe the conditions upstream of the plug and be prepared to immediately start bypass pumping, if needed.
- B. Any sump pumps, bypass pumps, trash pumps, or any other type of pump which pulls wastewater or any type of material out of the manhole or sewer shall discharge the material into another manhole, or appropriate vehicle or container approved by the Engineer. Under no circumstances shall this material be discharged, stored, or deposited on the ground, swale, road, or open environment.
- C. The Contractor shall take appropriate steps to ensure that all pumps, piping, and hoses that carry raw wastewater are protected from traffic. Traffic control shall be performed in accordance with the requirements of Section 01550.
- D. In the event that raw wastewater is spilled, discharged, leaked, or otherwise deposited in the open environment due to the Contractor's work, the Contractor shall be responsible for any cleanup of solids and stabilization of the area affected. This work shall be performed at the Contractor's expense with no additional cost to the City DWM. The Contractor shall also be responsible for notifying the sewer system maintenance personnel and complying with any and all regulatory requirements for cleaning up the spill at no additional cost to the City DWM.
 - 1. The release of raw wastewater onto the ground or into a receiving stream is prohibited. If such an incident occurs, report to City DWM immediately.
 - 2. In the event that such spillage or overflows do occur during the course of or as a result of the Work, immediately eliminate the spillage or overflow and, as necessary, remove the blockage, eliminate the back-up, and restore the pumping ability of the bypass pumping system.

3. On elimination of the spillage or overflow, clean up and disinfect the area.
 4. Work to stop or contain such events is to be deemed emergency in nature and sufficient justification for total mobilization of resources, the use of overtime or double time, and any other reasonable measures to assure correction of the problem without delay.
 5. The Contractor is responsible for damages arising from blockages, back-ups, spillage, or overflows of sewage during the course of the Work or because of the Work.
 6. The Contractor is responsible for paying all costs of clean-up and all fines imposed for overflows or spills during construction.
- E. During wastewater flow control operations, the Contractor shall take proper precautions to prevent damage to existing sanitary sewer facilities, flooding or damage to public or private property.
- F. The Contractor shall make repairs or replacements or rebuild such damaged section or sections of existing sewers. All such repairs, replacements, and rebuilding shall be paid for by the Contractor.
- G. The Contractor shall make such provisions as are necessary for handling all flows in existing sewers, connections, and manholes by pipes, flumes or by other approved methods at all times, when his operations would, in any way, interfere with normal functioning of those facilities.
- H. The Contractor shall be responsible for the removal of any debris and sedimentation in the existing sewers, laterals and manholes, etc., which is attributable to the Work.
- I. All operations shall be performed by the Contractor in strict accordance with OSHA and any applicable local safety requirements. Particular attention is directed to safety regulations for excavations and entering confined spaces.
- J.
- K. Piping used for temporary flow diversion of storm water and wastewater shall not be used for temporary flow diversion of potable water.
- L. The attachments listed below, following “End of Section” are a part of this Specification.
1. Bypass Pump System Start-up Checklist

+++ END OF SECTION 02600 +++

Bypass Pump System Start-up Checklist

This form must be completed prior to start-up of any bypass pumping system for the shutdown of a pump station.

Reason for Shutdown: _____

Lowest overflow point (provide location and elevation): _____

How long will pump station be off-line? _____

Pre-Start-up of Bypass Pumps

Task	Initials	
	Contractor	City DWM
Contractor to verify pumps have fuel.		
Contractor to verify all control floats properly set.		
Contractor to verify bypass tee isolation valve is open.		
Contractor to verify isolation valves on bypass piping are open.		
Contractor to set up air blower to circulate air into wet well.		
Contractor to check air quality in wet well for man entry.		
Contractor and City DWM to check for leaks in bypass piping from backpressure on force main.		
Contractor to check safety harness for personnel entering wet well or manhole.		

Obtain signatures of designated individuals upon completion of all checks.

Contractor

City DWM

SECTION 02607

MANHOLES, JUNCTION STRUCTURES, CATCH BASINS AND INLETS

PART 1 GENERAL

1.1 SCOPE

Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required to install cast-in-place manholes, junction structures, catch basins and inlets. All work shall be installed, adjusted, tested and placed in operation in accordance with these Specifications and the manufacturer's recommendations.

1.2 SUBMITTALS

Submittals shall be in accordance with the requirements of the Contract.

1.3 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards.
 - 1. ASTM C32 – Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
 - 2. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
- B. Prior to delivery, all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory or certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable.
- C. After delivery to the site, any materials, which have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the site.

1.4 WARRANTY

Provide a warranty against defective materials and workmanship in accordance with the requirements of the Contract.

PART 2 PRODUCTS

2.1 GENERAL

Cast-in-place manholes, junction structures, catch basins and inlets shall be constructed of specified materials to the sizes, shapes and dimensions required in accordance with City DWM standards.

2.2 MATERIALS AND CONSTRUCTION

A. Concrete and Reinforcement:

1. Concrete used for construction of manholes, junction structures, catch basins and inlets shall be 3000 psi concrete conforming to the requirements of Section 03055 - Concrete.
2. Steel reinforcement shall conform to the requirements of Section 03055.

B. The following sulfide resistant options shall be incorporated in the concrete mix design.

1. Sulfide Resistant Additive

- a. Where specified, a sulfide resistant additive shall be added to the concrete mix. The sulfite resistant additive shall permeate the concrete during the mixing phase and molecularly bond to the cement particles to become an integral component of the hardened concrete product and create an environment incompatible to thiobacillus bacteria growth and to inhibit microbial induced corrosion by preventing the thiobacillus bacteria from interacting with hydrogen sulfide gas and producing sulfuric acid.
- b. When the additive is used, it shall be introduced into the concrete mix at the pipe manufacturing facility, with one gallon of the additive replacing one gallon of water in each cubic yard of concrete produced.
- c. The Contractor shall include provisions in his Quality Control Plan to coordinate with the pipe manufacturer to verify that the additive is placed in the concrete mix in the proper amount on a uniform and consistent basis for all reinforced concrete sanitary sewer pipe produced for this Project requiring the additive.
- d. When the additive is used, the pipe manufacturer shall be required to provide special markings on each pipe section designating it a "special design for the City of Atlanta, containing Sulfide Resistant Additive". The manufacturer may also use a dye in the concrete mix to give the finished pipe section a unique color.
- e. The sulfide resistant additive shall be Con^{MIC}Shield[®], supplied by Vermillion and Associates, Chattanooga, Tennessee, or equal.

2. Sulfide Resistant Limestone Aggregate

- a. When used, the limestone aggregate shall permeate the concrete during the mixing phase and molecularly bond to the concrete particles to become an integrand component of the hardened concrete product and create an environment incompatible to thiobacillus bacteria growth and to inhibit microbial induced corrosion by preventing the thiobacillus bacteria interacting with the hydrogen sulfide gas and producing sulfuric acid.
- b. All precast concrete manholes shall be made with concrete with a minimum compressive strength per ASTM C478 and the absorption shall not exceed nine (9) percent. All cement and aggregate shall conform to the requirements of ASTM C478. Coarse aggregate shall be well graded limestone of a size that provides a homogenous concrete mixture, considering the pipe wall thickness. Fine aggregate shall consist of graded limestone sand, limestone screenings or natural sand that provides a homogenous concrete mixture, considering the pipe wall thickness.
- c. The minimum alkalinity of the hardened concrete, as determined by ASTM C497, shall not be less than 50% expressed as calcium carbonate (CaCO_3). Cement for pipe shall be Type I, Type II or Type I/II Portland cement.
- d. All admixtures shall be approved by the Contractor prior to use. Prior to manufacturing any pipe, the manufacturer shall submit the proposed concrete design mix with the estimated finished concrete alkalinity to the City DWM as part of the Project record. The requirements of this article shall apply to all reinforced concrete pipe manufactured under the requirements of ASTM C478.

3. Sulfide Resistant Coatings

- a. When used, all sulfide resistant coatings shall provide an impenetrable bond to the hardened surface of the concrete pipe. The coating shall prevent the bacillus bacteria from interacting with hydrogen sulfide gas and producing sulfuric acid on the surface of the concrete wall of the pipe.
- b. When a coating is used, it shall be applied at the concrete manufacturing facility, tested and inspected in accordance with the coating manufacturer's specifications. Specifications shall be submitted to the Contractor prior to use.
- c. The sulfide resistant coating shall be a polyurea elastomer coating or approved equal.

4. Sulfide Resistant Liners

- a. When used, all sulfide resistant liners shall be concrete poured against the lining and vibrated and compacted in a manner to protect the lining and to produce a dense homogenous concrete, securely anchoring the lining locking extensions into the concrete in accordance with the liner manufacturer's specifications and create an environment incompatible to thiobacillus growth, to inhibit microbial induced corrosion by preventing the thiobacillus bacteria from interacting with hydrogen sulfide gas and producing sulfuric acid.
- b. When a liner is used, it shall be installed at the concrete manufacturing facility, inspected and tested in accordance with the lining manufacturer's specifications. Liner joints shall be field welded in accordance with the liner manufacturer's recommendations.
- c. The sulfide resistant liner shall be Agru America HDPE Sure Grip Liner, GSE StudLiner, Ameron T-Lock Liner or equal.

B. Brick: Brick shall conform to the requirements of ASTM C32.

1. Brick used for construction of sewer inverts shall be Grade SS or SM.
2. Brick used for construction of manholes, junction structures, catch basins and inlets shall be Grade MS or MM.

C. Mortar: Mortar for brick masonry and similar work shall be composed of 1 part of Portland cement and 2 parts of mortar sand, by volume. Portland cement shall conform to the requirements of ASTM C150. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15 percent of the weight of cement used. Hydrated lime shall meet the requirements of ASTM C207, Type S.

D. Water: Water shall be clean and free of deleterious amounts of acids, alkalies, or organic material

E. Precast Concrete Manholes are specified in Section 02641.

F. Precast Concrete Manholes risers shall conform to the requirements of ASTM C478, unless noted otherwise on the plans.

G. Manhole frames, covers and steps are specified in Section 05500 – Miscellaneous Metals.

H. Frames and grates are specified in Section 05500 – Miscellaneous Metals.

PART 3 EXECUTION

3.1 CONSTRUCTION OF BRICK STRUCTURES

- A. Foundations: A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of 3000 psi reinforced concrete mixed, prepared, and placed in accordance with the requirements of 03055 - Concrete. The foundation shall be built to the correct elevation and shall be finished to cause the least possible resistance to flowing water.
- B. Laying Brick:
1. All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it, which can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Any bricks that may be loosened after the mortar has taken its set shall be removed, cleaned, and relaid with fresh mortar.
 2. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.
- C. Joints:
1. All joints shall be slushed with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint. Exterior faces shall be laid up in advance of backing. Exterior faces shall be back plastered or pargecoated with a coat of mortar not less than 1/2-inch thick before the backing is laid up. Prior to pargecoating, all joints on the back of face courses shall be cut flush.
 2. Unless otherwise noted, joints shall be not less than 1/4-inch or more than 1/2-inch wide and whatever width is adopted shall be maintained uniform throughout the work.
- D. Pointing: Face joints shall be neatly struck, using the weather joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used, the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.
- E. Cleaning: Upon completion of the work, all exterior surfaces shall be thoroughly cleaned by scrubbing and washing down with water and, if necessary to produce satisfactory results, cleaning shall be done with a 5 percent solution of muriatic acid which shall then

be rinsed off with liberal quantities of clean fresh water.

- F. Curing and cold weather protection: In hot or dry weather the brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost in the brick or when the air temperature is below 50 degrees F unless the Contractor has on the project, ready to use, suitable covering and artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60 degrees F for the duration of the curing period.

3.2 CONSTRUCTION OF CAST-IN-PLACE CONCRETE MANHOLES

- A. Cast-in-place manholes, excluding curved manhole bases, shall be constructed in place with the base, barrel, and conical section all monolithically cast using removable forms of material and design using industry-standard practice.
- B. The vertical forms, vertical and horizontal wall spacers, steps and placing cone shall be carefully positioned and firmly clamped in place before any placement is made. The wall spacers shall be located 90 degrees from each other. The forms shall be firmly supported with bottom of forms at the proper elevation to permit the base to be deposited through the vertical forms.
- C. No pipe penetration shall be formed within 12-inches of a corner, on a square bases, or within 12-inches of another penetration, in any direction, for circular bases.
- D. Concrete for manhole bases shall be deposited down through the wall forms onto undisturbed earth or shall be rock bearing. The concrete shall be evenly distributed around the walls and vibrated both inside and outside the forms until there is a minimum slope of 60 degrees from the bottom of the forms to the bearing surface both inside and outside of the manhole. When this is complete and before additional concrete is added, the concrete shall be carefully vibrated on each side of each sewer pipe.
- E. The base shall be concentric with the manhole, except where eccentric alignment with ladder is required, and have a minimum diameter of 4-feet or 16-inches greater than the outside diameter of the manhole whichever is greater, and 10-inches minimum thickness under the lowest pipe. Minimum wall thickness shall be 6-inches.
- F. Additional concrete shall be deposited in evenly distributed layers of approximately 18-inches with each layer vibrated to bond it to the preceding layer. The wall spacers shall be raised as the placements are made. The concrete in the area from which the spacer is withdrawn shall be vibrated. Excessive vibration shall be avoided.
- G. Grade adjustment rings shall be used to adjust manhole frame to grade and shall be precast reinforced concrete conforming to ASTM C478. Rings shall be free of cracks, voids and other defects. Adjustment rings shall be tested to assure compliance with impact and loading requirements in accordance with AASHTO's Standard Specifications.

- H. All manhole bases, including curved manhole bases and inverts shall be constructed of 3000 psi concrete in accordance with City DWM standards. Inverts shall be smooth and accurately shaped and have the same cross section as the invert of the sewers to which they connect. The manhole base and invert shall be carefully formed to the required size and grade by gradual and even changes in sections, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations. Changing directions of flow through the sewer shall be made to a true curve with as large a radius as the size of the manhole will permit. The invert and flow channel shall be formed during or immediately after the placing of the concrete and brush-finished as soon as the concrete has sufficiently set.
- I. Form marks and offsets shall not exceed 1-inch on the outside surface of the manhole. Form marks and offsets shall not exceed 1/2-inch inside of the manhole. All offsets on the inside surface of the manhole shall be smoothed and rubbed so there is no projection or irregularity capable of scratching a worker or catching and holding water or other materials. Honeycombed areas shall be completely removed immediately upon removal of the forms and replaced with a 3000 psi concrete or patched with epoxy grout.
- J. Should circumstances make a joint necessary, a formed groove or reinforcing dowels shall be required in the top of the first placement for shear protection. Immediately before the second placement is made, the surface of the cold joint shall be thoroughly cleaned and wetted with a layer of mortar being deposited on the surface.
- K. Concrete setting time and backfilling shall be in accordance with the applicable requirements of Section 03055 - Concrete. Masonry work shall be allowed to set for a period of not less than 24 hours. Outside forms, if any, then shall be removed and the manhole backfilled and compacted. All loose or waste material shall be removed from the interior of the manhole. The manhole cover then shall be placed and the surface in the vicinity of the work cleaned off and left in a neat and orderly condition.

3.3 PIPE CONNECTIONS AT STRUCTURES

Pipes shall extend through the walls of the structure as required. The pipes shall be cut off flush with the structure wall on the inside surface. For cast-in-place concrete or brick structures, mortar shall be placed around the pipes so as to form a neat, watertight connection.

3.4 MANHOLES AND JUNCTION STRUCTURES OVER EXISTING SEWERS

- A. Construct manholes and/or junction structures over existing operating sewer lines at required locations. Perform necessary excavation, break into existing sewer and construct manhole.
- B. Maintain flow through existing sewer lines at all times and protect new concrete and mortar work for a period of 7 days after the concrete has been placed. Advise the City

DWM of plans for diverting wastewater flow and obtain approval before starting in accordance with Section 02600. City DWM's approval will not relieve the Contractor of responsibility for maintaining adequate capacity for flow at all times and adequately protecting new and existing work.

- C. Construct the new base under the existing sewer and install precast sections or cast-in-place walls as specified above.
- D. Break out the existing sewer within the new manhole, cover the edge of the sewer with mortar, and trowel smooth.

3.5 INSPECTION AND TESTING

After completion, all manholes will be inspected. The Contractor is required to provide access and equipment to the inspector for the safe review of the system. The Contractor shall make, at Contractor's expense, all necessary changes, modifications and/or adjustments required to assure satisfactory operation.

+ + + END OF SECTION 02607 + + +

SECTION 02641

PRECAST CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes precast concrete manholes installation; frames and covers; pipe connections at manholes; manhole testing; backfill; cleanup; and any other similar, incidental, or appurtenant operation which may be necessary to properly complete the Work.
- B. The Contractor shall provide all services, labor, materials, and equipment required for all precast concrete manholes and related operations necessary or convenient to the Contractor for furnishing a complete Work as shown on the Plans or specified in these Specifications.
- C. Related Sections Specified Elsewhere:
 - 1. Section 01200 - Measurement and Payment
 - 2. Section 03055 - Concrete

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided.

The Contractor shall submit manufacturer's data and details of the following items for approval:

- A. Shop drawings of manhole sections and base units and construction details, including reinforcement, jointing methods, and materials.
- B. Summary of criteria used in the manhole design including, as a minimum, material properties, loadings, load combinations, and dimensions assumed.
- C. Materials to be used in fabricating drop connections.
- D. Materials to be used for pipe connections at manhole walls.
- E. Materials to be used for stubs and stub plugs, if required.
- F. Materials and procedures for corrosion resistant liner and coatings, if required.
- G. Plugs to be used for vacuum testing.

- H. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.
- I. Description of the proposed method of concrete curing.

1.3 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Plans or specified in these Specifications.
 - 1. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 2. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets.
 - 3. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 4. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 - 5. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (non-shrink).
- B. Prior to delivery, all basic materials specified in this section shall be tested and inspected by an approved independent commercial testing laboratory or, if approved by the Engineer, certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable. All materials which fail to conform to these Specifications shall be rejected.
- C. After delivery to the site of the Work, any materials which have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the site of the Work.
- D. Precast concrete producer shall demonstrate adherence to the standards set forth in the National Precast Concrete Association Quality Control Manual. Precast concrete producer shall meet requirements written below.

Qualifications, Testing and Inspection

- 1. The Precast concrete producer shall have been in the business of producing precast concrete products similar to those specified for a minimum of 5 years. The precast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the precast concrete producer to produce quality products consistent with industry standards.
- 2. The Precast concrete producer shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests

shall be performed for each 150 cu. yd. of concrete placed, but not less frequently than once per week.

- a. Slump: C143
 - b. Compressive Strength: C31, C192, and C39
 - c. Air Content (when air-entrained concrete is being used): C231 or C173
 - d. Unit Weight: C138
3. The Precast concrete producer shall provide documentation demonstrating compliance with this subparagraph.
 4. The plant shall notify the Engineer when the pre-cast products are being produced for the project. The City may place an inspector in the plant when the products covered by this specification are being manufactured.”

1.4 DESIGN CRITERIA

Manholes shall be constructed of specified materials to the sizes, shapes, and dimensions and at the locations shown on the Plans or as otherwise directed by the Engineer. The height or depth of the manhole will vary with the locations, but unless shown otherwise on the Drawings shall be such that the top of the manhole frame will be at the finished grade of the pavement or higher than the ground surface as shown on the Drawings and the invert will be at the designed elevations.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Unless specified otherwise in the Drawings or in the Special Conditions, all manholes will be precast concrete manholes as specified in this section.
- B. The precast reinforced concrete manholes shall be constructed in accordance with the requirements of ASTM C478. Reinforced concrete manholes shall consist of manhole base sections, riser sections, transition sections, and conical sections as described in this section. The manhole components shall be configured to minimize the number of joints required per manhole. The Engineer may require any manhole that is not composed of the minimum number of sections to be replaced.
- C. Portland cement concrete used in the precast reinforced concrete manholes shall have a minimum compressive strength of 5,000 psi at twenty-eight (28) days.
 1. The concrete shall contain Type II Portland cement with a C3A content of five and one-half (5½) percent or less and meet the requirements of ASTM C478.
 2. Aggregate for concrete, except for maximum size and gradation, shall be as specified in applicable sections of these Specifications.

3. To aid in achieving the specified concrete compressive strength, newly cast manholes shall be cured in accordance with the requirements of ASTM C478. The method of curing proposed must be submitted to the Engineer prior to manufacture. Manholes shall be cured for a minimum of seven (7) days prior to shipment to the site unless otherwise instructed by the Engineer.
4. The manhole manufacturer shall test the compressive strength of a minimum of two (2) concrete cylinders per calendar week. Reports verifying the results of the compression tests shall be maintained at the manufacturer's facility. Reports shall be made available for inspection and review by the City's representatives. The manhole manufacturer shall permit the City's representatives to make unannounced reviews of compression test records and inspection of manufacturing facilities at any time during normal business hours.
5. The manhole manufacturer shall notify the City of all manholes delivered for use in the City's sanitary sewer system which were manufactured during a week for which a concrete compressive strength test yielded a result of less than 5,000 psi.

- a. Such notification shall be in the form of a letter sent to:

City of Atlanta Department of Watershed Management
Construction Management Group
750 Selig Drive, Suite F
Atlanta, GA 30336
Attention: City Construction Manager

- b. Notification shall include (at a minimum) the project name, Contractor name, date of manhole component manufacture, and description of manhole component(s) affected.
- c. The City may require additional testing, repairs, or removal and replacement, at no additional cost to the City, of any or all manhole components provided for use in the City's sanitary sewer systems which were manufactured during a calendar week for which a concrete compressive strength test yields a result of less than 5,000 psi.

- D. Reinforcing steel shall be bars of intermediate grade, open hearth, billet steel, conforming to the requirements of ASTM A615, or Cold-Drawn Steel Wire for Concrete Reinforcement conforming to the requirements of ASTM A82; or of wire fabric conforming to the requirements of ASTM A185. The circumferential reinforcement in the riser and conical top sections shall have an area of not less than 0.12 square inches per linear foot.
- E. The interior and exterior surfaces of the manhole shall have a smooth hard finish, and shall be free from cracks, chips, and spalls.

- F. The maximum allowable absorption of the concrete used for manhole construction shall not exceed eight (8) percent of the dry weight.
- G. Manhole base sections shall be circular, wet cast, and may be supplied in forty-eight (48) inches, sixty (60) inches, seventy-two (72) inches, eighty-four (84) inches, and ninety-six (96) inches diameters. Heights shall range from forty-eight (48) inches to ninety-six (96) inches depending on availability with diameter and as specified or approved by the Engineer. All base sections shall be supplied with Manhole Lift System inserts as manufactured by Press-Seal Gasket Corporation. Lifting eye bolts, also manufactured by Press-Seal Gasket Corporation, shall be supplied to the Contractor upon request. Manhole bases manufactured with pipe openings eighteen (18) inches or less shall be furnished with Kor-N-Seal flexible pipe-to-manhole connectors. Pipes with diameters greater than eighteen (18) inches shall be secured with a concrete cradle installed to the springline of the pipe utilizing Class "B" concrete conforming to the requirements of Section 03055.
- H. Riser sections shall be circular, wet or dry cast, and may be supplied in forty-eight (48) inches, sixty (60) inches, seventy-two (72) inches, eighty-four (84) inches and ninety-six (96) inches diameters. Heights shall range from sixteen (16) inches to forty-eight (48) inches in sixteen (16) inch multiples depending on availability with diameter and as specified or approved by the Engineer. All riser sections shall be supplied with Manhole Lift System inserts as manufactured by Press-Seal Gasket Corporation. Lifting eye bolts, also manufacture by Press-Seal Gasket Corporation, shall be supplied to the Contractor upon request.
- I. Transition sections shall be wet or dry cast. Conical transition sections shall be supplied for sixty (60) inches to forty-eight (48) inches diameter transitions. Conical transitions shall be thirty-two (32) inches high. Sixteen (16) inches high conical transitions may only be used when approved by the City. All conical transition sections shall be supplied with a Manhole Lift System as manufactured by Press-Seal Gasket Corporation. Flat slab transitions shall be supplied for base sections seventy-two (72) inches to ninety-six (96) inches in diameter. Flat slab transitions shall be manufactured structurally to meet individual project requirements. Clear access openings shall be provided to accommodate riser sections as shown in the Plans or as detailed in the Drawings.
- J. Conical sections shall be wet or dry cast, eccentric only. Concentric sections will not be allowed. Conical sections shall transition from forty-eight (48) inches diameter to a twenty-four (24) inches clear access opening and be thirty-six (36) inches high. They shall be supplied with a Manhole Lift System as manufactured by Press-Seal Gasket Corporation

- K. Precast manhole riser joints shall be offset tongue and groove type, supplied with Tylox Super Seal pre-lubricated gasket as manufactured by Hamilton Kent. Each joint shall also be supplied with Conseal CS-231 waterstop sealant as manufactured by Concrete Sealants, in widths as recommended by the manufacturer.
- L. The ends of each reinforced concrete manhole riser section and the bottom end of the manhole top section shall be so formed that when the manhole risers and the top are assembled, they will make a continuous uniform manhole.
- M. Standard manholes of precast concrete construction, and other manholes of precast concrete construction having entering sewers of twenty-four (24) inches diameter or smaller shall have precast openings in the manhole walls for incoming or outgoing sewers as indicated on the Plans.
- N. All components of a manhole for a particular location shall be clearly marked in order that the manhole may be correctly assembled to suit construction conditions existing at that particular location.
- O. All precast concrete manhole base sections and drop manhole bases shall be set on a foundation of #57 compacted stone aggregate, twelve (12) inch minimum thickness, and covering the entire bottom of the excavation for the manhole. Aggregate size may be adjusted by the Engineer based on field conditions.
- P. Manhole steps shall conform to the requirements of this section.

2.2 STRUCTURAL MATERIALS AND CASTINGS

- A. Structural steel shall conform to the requirements of ASTM A283, unless otherwise indicated on the Plans.
- B. Steel castings shall conform to the requirements of ASTM A27. The grades to be used will be specified in the Special Conditions or indicated on the Plans.
- C. Gray iron castings shall conform to the requirements of ASTM A48. All castings shall be clean and free of scale, adhesions, or inclusions. Gray iron castings for manhole or inlet frames and covers or gratings shall be cast from Class 30B cast iron. Bearing surfaces between manholes, inlet frames, and covers or gratings shall be such that the cover or grating shall seat in any position onto the frame without rocking. Bearing surfaces for standard manhole frames and covers shall be machined.
- D. Aluminum castings shall conform to the requirements of ASTM B108.

- E. Structural aluminum shall conform to the requirements of either ASTM B209, B221, B308, B241, or B211, as applicable. Finished bolts and nuts shall be given an anodic coating of at least 0.0002 inches in thickness.

2.3 FRAMES, COVERS, AND STEPS

- A. New manhole rims, toe pockets, frames, and covers shall be cast iron conforming to the requirements of ASTM A48 for Class 30 Gray Iron Castings. All castings shall be made accurately to the required dimensions, fully interchangeable, sound, smooth, clean, and free from blisters or other defects. Defective castings which have been plugged or otherwise treated shall not be used. All castings shall be thoroughly cleaned and painted or coated with bituminous paint. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.
- B. Manhole frames and covers shall be as detailed on the Plans, and as manufactured by Vulcan Foundry, or as manufactured by the Griffin Foundry Co., Russell pipe & Foundry Co., or equal. Manhole covers shall be vented except those located within the one-hundred (100) year flood plain, within three (3) feet of curb for a two (2) lane road, or within the outside lane of a multi-lane road.
- C. Sanitary sewer manhole covers shall have the words cast on the top in letters two (2) inches high per the City Standard Detail.
- D. Manhole inlet steps shall be made of steel reinforced copolymer polypropylene model PS-1 PF. They shall be installed at maximum sixteen (16) inch intervals. Manhole steps shall be as shown in the Detail Drawings with rod and pull ratings meeting OSHA standards.

2.4 SPECIALTY ITEMS

- A. One piece manholes shall be manufactured in accordance with the requirements of ASTM C478 and as detailed in the Detail Drawings. They shall be cast utilizing 5,000 psi concrete containing type II cement with a C3A content of five and one-half (5½) percent or less. They shall be manufactured within a minimum eight (8) inches thick base with dowel steel reinforcement and waterstop. They shall be used only in situations which will not accommodate a twenty-four (24) inch base section and twenty-four (24) inch conical section.
- B. 36" x 48" Manhole Tees shall be manufactured in accordance with the requirements of ASTM C478 and as detailed in the Detail Drawings. They shall be cast utilizing 5,000 psi concrete containing type II cement with a C3A content of five and one-half (5½) percent or less.
- C. Saddle manholes shall be manufactured in accordance with the requirements of ASTM C478 and as shown in the Detail Drawings. They

shall be cast utilizing 5,000 psi concrete containing type II cement with a C3A content of five and one-half (5½) percent or less.

- D. Drop Manholes (Memphis Tees) shall be manufactured in accordance with the requirements of ASTM C478 and as detailed in the Detail Drawings. They shall be cast utilizing 5,000 psi concrete containing type II cement with a C3A content of five and one-half (5½) percent or less.

2.5 BRICK

- A. Brick shall comply with the following requirements for which its use is intended. Bricks with holes through them will not be allowed in the Work.
- B. Bricks used to adjust manhole frame to grade shall conform to the requirements of ASTM C32 for grade SM. Bricks shall conform to the following dimensions, unless otherwise approved by the Engineer.

	Depth (Inches)	Width (Inches)	Length (Inches)
Standard Size	2- ¹ / ₄	3- ³ / ₄	8
Allowable Variation	+ ¹ / ₄	+ ¹ / ₄	+ ¹ / ₂

- C. All brick shall be new and whole, of uniform standard size, and with substantially straight and parallel edges and square corners. Bricks shall be of compact textures, burned hard entirely through, tough and strong, free from injurious cracks and flaws, and shall have a clear ring when struck together. No soft or salmon brick shall be used in any part of the Work. Brick shall be culled after delivery, if required, and no culls shall be used except at such places, to such extent, and under such conditions as may be approved by the Engineer.

2.6 CONCRETE

Concrete shall conform to requirements of Section 03055, Concrete.

2.7 MORTAR

Mortar shall be prepared only in the quantities needed for immediate use. Mortar which has been mixed for more than thirty (30) minutes or which has set or has been retempered shall not be used in the Work.

PART 3 - EXECUTION

3.1 GENERAL

- A. All activities shall be performed in accordance with the manufacturer's recommendations and regulations established by OSHA. Particular attention shall be drawn to those safety requirements involving working with scaffolding and entering confined spaces.
- B. The Contractor shall verify that lines and grades are as specified in the Drawings.

3.2 INSTALLATION

- A. Manholes shall be constructed to the sizes, shapes, and dimensions as detailed in the Detail Drawings and at the locations shown on the Plans. They shall be constructed of precast concrete sections conforming to the requirements of this section. The manholes shall be assembled with the fewest number of sections to make up required height, thereby reducing the number of joints. The composition of the manhole must be approved by the Engineer. The Engineer may require any manhole that is not composed of the minimum number of sections to be replaced. The depth of the manhole will vary with the location but in all cases it shall be such as will place the cover (or lid) at the finished grade of the pavement or ground surface or as otherwise indicate on the Plans. In undeveloped or rural areas, manholes shall be furnished to a height of two (2) feet above ground. Concentric cone sections and flat top manholes, except for shallow depth where approved by the Engineer, will not be allowed; only eccentric cones will be used.
- B. Precast concrete manholes for reinforced concrete sewers forty-eight (48) inches diameter and larger shall be as specified above, except that they shall be installed on a saddle constructed on the barrel of the sewer. Precast concrete manholes for sewers thirty (30), thirty-six (36), and forty-two (42) inches shall be saddle-types or precast base types as specified in the Plans. Reinforcing steel in the saddle shall be welded to the reinforcing steel of the pipe. The design of these saddles shall be approved by the Engineer prior to manufacture.
- C. All joints for precast manhole stacks shall be offset tongue and groove with Tylox Super Seal pre-lubricated gaskets as manufactured by Hamilton Kent. Each joint shall also be sealed with Conseal CS-231 waterstop sealant as manufactured by Concrete Sealants. The width and installation of the joint sealant shall be in accordance with the manufacturer's recommendations. All joints shall be supplied with 3" x 16" x 1/2" inch bitumastic coated steel strap anchors. Three (3) strap anchors, one-hundred and twenty (120) degrees apart shall be required per joint.

- D. Where the difference in the invert elevation of two (2) or more sewers, eighteen (18) inches in diameter or smaller, intersecting in one (1) manhole is two (2) feet or more, a Drop Manhole (Memphis Tee) shall be constructed in the manner shown in the Detail Drawings. They shall be similar in construction to the standard manhole, except that a drop connection of a pipe and fittings of the proper size and material shall be constructed outside the manhole and supported by Class B concrete as indicated on the Plans and in the Detail Drawings. The manhole and the drop connection shall be placed on twelve (12) inch reinforced concrete base as detailed in the Detail Drawings. The drop connection piping assembly shall be bolted to the barrel of the manhole riser using a minimum of four 5/8-inch diameter stainless steel (316) bolts with suitable washers to prevent failure caused by pulling the bolt head through the manhole wall.
- E. Base sections shall be precast with the vertical walls of sufficient height to allow entry of the required pipes as shown on the Plans, and as detailed in the Detail Drawings. Manhole inverts shall be constructed of cement mortar and shall have the same cross-section as the invert of the sewers which they connect. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in direction of flow through the sewer shall be made to a true curve with as large a radius as the size of the manhole will permit.
- F. All water standing in the trench shall be removed before placing of concrete is started, and the foundation maintained in a dry condition.
- G. Shallow manholes shall be constructed to the sizes, shapes, and dimensions as detailed in and at the locations shown on the Drawings. They shall be constructed of precast concrete sections as shown on the Drawings and as directed by the Engineer.
- H. The top elevation of manhole frames shall be adjusted to grade in areas such as streets, alleys, and parking lots or where indicated on the Plans. A maximum adjustment of twelve (12) inches will be allowed using brick and mortar. Adjustments greater than twelve (12) inches must be made by changing precast riser sections. Brick used will be in accordance with the requirements of this section.

3.3 PIPE CONNECTIONS AT MANHOLES

- A. Openings in manhole walls for incoming and outgoing sewers shall be precast or cored and after installation sealed with an approved non-shrink grout. These manholes shall be installed on a choked and compacted stone bedding as detailed in the Detail Drawings.
- B. A flexible manhole connector may be approved by the Engineer as an alternate method of sealing the space between the manhole wall and the

pipe. Flexible manhole sleeves shall be required for all pipes eighteen (18) inches and smaller. The manhole connector shall be Kor-N-Seal or equal and conform to the requirements of ASTM C923 and shall be made from ethylene propylene rubber (EPDM) designed to be resistant to ozone, weather elements, chemicals, including acids, alkalis, animal and vegetable fats, oils, and petroleum products. Manhole sleeves shall be secured to pipe by stainless steel clamp and bolt assembly conforming to the requirements of ASTM C923 and ASTM A167.

- C. All stainless steel elements of the manhole connector shall be totally non-magnetic Series 304 Stainless, excluding the worm screw for tightening the steel band around the pipe which shall be Series 305 Stainless. The worm screw for tightening the steel band shall be torqued by a break-away torque wrench available from the precast manhole supplier, and set for 60-70 inch/lb. The connector shall be installed in the manhole wall by activating the expanding mechanism in strict accordance with the recommendation of the connector manufacturer. The connector shall be of a size specifically designed for the pipe material and size being utilized on the Project.

3.4 MANHOLE TESTING

All manholes shall be vacuum tested in accordance with the requirements of Section 02650, Testing for Acceptance of Sanitary and Storm Sewers.

3.5 BACKFILL

The Contractor shall place and compact backfill materials, in the area of excavation surrounding manholes in accordance with the requirements of Section 02607, Manholes, Junction Boxes, Catch Basins and Inlets.

3.6 CLEANUP

After the manhole installation work has been completed and all testing accepted by the Engineer, the Contractor shall cleanup the area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor. Disturbed grassed areas shall be seeded or sodded.

END OF SECTION

SECTION 02650

TESTING FOR ACCEPTANCE OF SANITARY AND STORM SEWERS

PART 1 GENERAL

1.1 SCOPE

- A. This section includes sanitary and storm sewer inspection and testing methods; joint testing procedures; manhole testing methods; allowable testing limits for sanitary sewers; and any other incidental or appurtenant operations which may be necessary to properly complete the Work.
- B. The Contractor shall provide all labor, materials, and equipment required for all sanitary and storm sewers testing and related operations necessary or convenient for completing the Work.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the Contract.

1.3 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards.
 - 1. ASTM C828 – Test Method for Low-pressure Air Test of Vitrified Clay Pipe Lines
 - 2. ASTM C969 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
 - 3. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
 - 4. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
 - 5. ASTM F1417 – Standard Practice for Installation Acceptance of Plastic non-pressure Sewer Lines Using Low Pressure Air

1.4 ACCEPTANCE TESTS

- A. Upon completion of all or a part of a sanitary sewer installation, the Contractor shall test and/or inspect the sewer for acceptability. The method(s) of testing and/or inspection shall be as specified by the Contractor and industry standards. Testing and inspection

shall be performed in accordance with the requirements of this Section.

B. One or more of the following tests and/or inspections may be required:

1. Infiltration of Water
2. Exfiltration of Water
3. Exfiltration of Air under Pressure
4. Smoke Testing
5. Joint Testing
6. Direct Visual Inspection
7. Deflection Testing
8. Dye Testing
9. Closed Circuit Television Inspection (CCTV).

C. The Contractor shall notify the City DWM 48 hours in advance prior to the Contractor performing any testing.

D. Prior to any testing, all lines shall be cleaned of debris and flushed clean. Debris shall be caught and removed from the line and shall not be flushed into existing live sanitary sewers.

1.5 TEST SECTIONS

The Contractor may at his option divide the installed sewer into subsections of more convenient length for testing. If the section or subsection tested does not pass the tests, it shall be repaired and the test repeated until a satisfactory test is obtained.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.1 SANITARY AND STORM SEWER INSPECTION AND TESTING METHODS

- A. All Testing Methods: All wyes, tees, and stubs shall be plugged with flexible jointed caps, or acceptable alternate, and securely fastened to withstand the internal test pressure. Plugs or caps shall be readily removable.

- B. The Contractor shall clean and test lines before requesting final acceptance. Where any obstruction is met, the Contractor shall clean the sewers by means of rods, swabs, or other instruments. Contractor shall flush out lines and manholes before final inspection.
- C. Pipelines shall be straight and show a uniform grade between manholes, except for curves specifically shown. The Contractor shall correct any discrepancies discovered during inspection at no cost to the City DWM.

D. Watertightness

- 1. All sewers constructed shall be tested for watertightness. Infiltration and exfiltration tests shall be performed on all new sewers constructed as specified in this section, except for those new sewers constructed which have active services tied into them as the pipe is being installed. In such cases the watertightness of the sewers less than or equal to thirty-six (36) inches in diameter shall be based on a visual inspection, and for sewers forty-two (42) inches in diameter and larger based on the individual joint test as specified in this section.
- 2. All visible leaks, regardless of the amount of leakage, shall be repaired at the Contractor's expense.

E. Infiltration Tests

- 1. The Contractor shall install weirs in manholes to determine the leakage of ground water into the sewer. The Contractor shall install weirs for a minimum of four hours before measuring flow. If leakage in any section of the sewer line exceeds one hundred (100) gallons per inch of diameter per day per mile, the Contractor shall locate and repair leaks. Repair methods shall be in accordance with industry standards. After repairs are completed, the Contractor shall re-test for leakage.
- 2. Infiltration testing shall be performed before sanitary sewer lateral connections or reconnections are made.
- 3. The Contractor shall furnish, install and remove the weirs, plugs, and bulkheads required to perform the leakage tests.
- 4. Weirs shall be V-notch type equal to Pollard.

F. Exfiltration Tests

- 1. Low-Pressure Air Test:
 - a. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections

using inflatable balls pulled through the line from manhole to manhole.

- b. Air shall be slowly supplied to the plugged sewer section until the internal air pressure reaches approximately four (4) psi. After this pressure is reached and the pressure allowed to stabilize (approximately two (2) to five (5) minutes), the pressure shall be reduced to three and one-half (3.5) psi before starting the test.
- c. Record the drop in pressure for the test period. If the pressure drop is equal to or less than one (1) psi during the test time, then the line will pass the test. If the pressure drops more than one (1) psi during the test time, the line will fail the test and the Contractor shall locate the failure, make necessary repairs, and retest the line.
- d. The minimum test time for various pipe sizes and types is as follows:

Nominal Pipe Size (Inches)	Time (Min/100 feet)	
	VCP, RCP	DIP, PVC
6	0.7	5.7
8	1.2	7.6
10	1.5	9.4
12	1.8	11.3
15	2.1	14.2
18	2.4	17.0
21	3.0	19.8
24	3.6	22.8
30	4.8	35.4
36	6.0	51.2
42	7.3	69.5

- e. Required test equipment, including inflatable balls, braces, air hose, air source, time meter, rotameter as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of $\pm$ two (2) percent shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing Systems.
- f. The Contractor shall keep records of all tests made. Copies of records shall be given to the City DWM. Records shall show date, line number and stations, operator, and such other pertinent information to identify the pertinent test data.
- g. The Contractor shall take safety precautions in the performance of the air testing. Plugs shall be properly secured and care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

2. Individual Joint Test: Pipe joints for sewers thirty (30) inches in diameter and larger shall be air tested individually. The joint tester assembly shall be placed over the joint and the joint area pressurized to four (4) psi. The pressure shall not drop more than two (2) psi in ten (10) seconds. The joint tester assembly shall be equal to Cherne Industries, Inc.

G. Smoke Testing

1. Smoke testing may be used only to locate leaks and in no case shall be considered conclusive or a substitute for air tests, infiltration tests, or exfiltration tests. In all cases a smoke test shall be accompanied by an air test, infiltration test or exfiltration test. The Contractor may order a smoke test if another leakage test fails and the source of the leak cannot be determined by other means. Smoke testing shall only be performed where ground water is low. Smoke shall be blown into a sealed section of sewer under pressure and the Contractor and City DWM shall observe for any smoke appearing on top of the ground indicating the presence of leaks.
2. The City DWM may require that the Contractor excavate the sewer to determine the source of any smoke appearing during the smoke test. All leaks or breaks discovered by the smoke tests shall be repaired and/or corrected by the Contractor at his own expense. Equipment and supplies required for smoke tests shall be furnished by the Contractor.
3. The Contractor may perform smoke tests at any time during construction at his option; however, any such tests shall not supplant the final test of the completed work.

H. Deflection Test

1. The Contractor shall test all PVC gravity sewers for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed five (5) percent.
2. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe. The mandrel shall have an odd number of legs, or vanes, with a quantity equal to or greater than nine (9). The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel, aluminum, or other industry accepted material and shall have sufficient rigidity so the legs of the mandrel will not deform when pulled through the pipe. The Contractor shall provide a proving ring for each size mandrel, with a tolerance of no more than 0.02-inch clearance, and the mandrel dimensions shall be checked using this proving ring, before use by the Contractor.
3. The Contractor shall excavate and properly install any section of pipe not passing this test and re-test until results are satisfactory.

4. This test shall be performed twice:
 - a. Once within the first thirty (30) days of installation, and
 - b. Once during final inspection, but no sooner than thirty (30) days after pavement backfill is done, at the completion of this Contract.

I. Dye Testing

1. Dye testing shall be used only to confirm service connection or disconnection and in no case shall be considered conclusive or a substitute for air tests, infiltration tests or exfiltration tests. Dye testing shall only be performed where ground water is low. Dye shall be introduced into the service lateral and the Contractor and City DWM shall observe for any dye appearing on sanitary or storm sewers. Equipment and supplies required for dye tests shall be furnished by the Contractor.
2. The Contractor may conduct dye tests at any time during construction at his option; however, any such tests shall not supplant the final test of the completed work.

J. Closed Circuit Television Inspection

1. The interior of all new gravity sewers shall be subjected to a televised inspection.
2. Prior to Final Acceptance the City DWM shall be provided with one copy of the TV inspection report and CD-ROMs showing the entire length of the gravity sewer tested. The report shall contain the condition of pipe, type of pipe, depth, location of services, length, type of joints, roundness and distance between manholes. Any pipe found to be cracked, leaking, misaligned, bellied, or otherwise defective shall be removed and replaced by the Contractor.

3.2 JOINT TESTING PROCEDURES

- A. Joint Testing Procedures: Each sanitary sewer joint shall be individually air tested using a packer or other approved testing device at a test pressure of four (4) psi plus one-half (1/2) psi per vertical foot of depth up to a maximum of ten (10) psi. The packer or testing device shall be positioned within the sanitary sewer so as to straddle the joint to be tested. The ends of the packer or testing device shall be expanded to isolate the pipe joint from the remainder of the sewer and create a void space between the packer or testing device and the pipe joint. The sealing elements shall be inflated with air in accordance with the test equipment manufacturer's instructions. Air shall then be introduced into the void space until the required test pressure is recorded on the void pressure meter. If the required test pressure cannot be developed, the joint will fail the test. After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the pressure holds or drops less than two (2) psi in fifteen (15) seconds, the joint is acceptable.
1. All test monitoring shall be above ground and in a location to allow for simultaneous and continuous observation by the City DWM. The void pressure data shall be

transmitted electronically from the void to the monitoring equipment.

2. Prior to starting the sanitary sewer joint testing, a two (2) part control test shall be performed as follows:
 - a. A demonstration test shall be performed in a test cylinder constructed in such a manner that a minimum of three (3) known leak sizes (0.062, 0.094, 0.125 inch diameter) can be simulated. During the demonstration test, the Contractor shall use a test cylinder gauge to measure void pressure. The Contractor shall also install the void pressure monitoring equipment in the same manner as will be done to measure the void pressure at a sanitary sewer joint. The Contractor shall then apply pressure to the void space. During the demonstration test, the void pressure reading on the test cylinder gauge shall be the same as that observed on the void pressure monitoring equipment at all times during the test. If the pressure reading on the test cylinder gauge is not the same as the pressure reading observed on the void pressure monitoring equipment at all times, the Contractor shall repair or otherwise modify the packer or testing device and perform the test until the results are satisfactory to the City DWM. The demonstration test may be required, by the City DWM, at any other time during the joint testing work.
 - b. Upon entering each manhole to manhole section with the test equipment, but prior to the commencement of joint testing, the packer or testing device shall be positioned on a section of sound sanitary sewer between pipe joints. The Contractor shall then perform the test at the required pressure.
3. During the sanitary sewer joint testing work, the Contractor shall keep the following records:
 - a. Manhole to manhole section tested.
 - b. Test pressure used.
 - c. Location (footage) of each joint tested.
 - d. Test results for each joint tested.

- B. Lamping Procedures: Lamping will be performed on all sewer pipelines by the Contractor.

3.3 MANHOLE TESTING

- A. All new manholes, rehabilitated manholes, manhole inserts and replacement manholes shall be tested by the Contractor using the vacuum test method, following the manufacturer's recommendations. Vacuum testing of manholes and structures shall be performed after curing of linings and installation of inserts. Any leakage in the manhole or structure, before, during, or after the test shall be repaired at no cost to the City DWM.
- B. Prior to testing manholes for watertightness, all lift holes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and braced.

C. Vacuum Tests:

1. The manhole, after preparation as noted above, shall be vacuum tested. All testing shall be performed in accordance with the requirements of ASTM C1244. A vacuum shall be drawn and the vacuum drop over a specified time period shall be used to determine the acceptability of the manhole.
2. The test head shall be placed at the inside of the top of the manhole in accordance with the manufacturer's instructions. A vacuum of ten (10) inches of mercury [five (5) psi] shall be drawn on the manhole, the valve on the vacuum line of the test head closed and the vacuum pump shut off. The time shall be measured for the vacuum to drop from ten (10) inches of mercury [five (5) psi] to nine (9) inches of mercury [four and one-half (4.5) psi]. The manhole shall pass the vacuum test if the time for the vacuum reading to drop from 10-inches of mercury to 9-inches of mercury meets or exceeds the values indicated in the table below.

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS				
	Manhole Diameter (Inches)			
	48	60	66	72
Depth (Feet)	Time (Seconds)			
8	20	28	29	33
10	25	33	36	41
12	30	39	43	49
14	35	48	51	57
16	40	52	58	67
18	45	59	65	73
20	50	65	72	81
22	55	72	79	89
24	59	78	87	97
26	64	85	94	105
28	69	91	101	113
30	74	96	108	121

- D. For manholes less than 8-feet in depth, the minimum value listed shall be used.
- E. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout. Retesting shall proceed until a satisfactory test is obtained.
- F. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc.
- G. The City DWM reserves the right to have third party consultants perform construction materials testing and assessments to any new manhole.

3.4 ALLOWABLE TESTING LIMITS FOR SANITARY SEWERS

- A. No infiltration and exfiltration of ground water or other leakage into or out of the sewer shall be allowed during the twenty-four (24) hour test period.
- B. Any visible or audible leaks into the sewer shall be repaired or corrected in accordance with industry standard methods.

+ + + END OF SECTION 02650 + + +

SECTION 02711

CHAIN LINK FENCE AND GATES

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to furnish and install chain link fence, gates and appurtenances as shown on the Drawings and as specified herein. Chain link fence shall be of the types indicated as follows:
 - 1. Zinc-coated steel fence fabric with galvanized steel posts, rails, caps, hardware and fittings.
 - 2. Polyvinylchloride (PVC) coated steel fence fabric with vinyl coated and factory-painted steel posts, rails, caps, hardware and fittings in a color to be determined by the Owner.
- B. Fencing and gates shall be installed in the locations as shown on the Drawings or as directed by the Engineer, in complete conformity with the manufacturer's written recommendations and as specified herein.
- C. The Contractor shall also furnish all labor, materials, equipment and miscellaneous items as necessary for the removal and re-installation of existing chain link fence and gates as required for construction of the project.
- D. Security fencing for the Contractor is at Contractor's option and is not included as part of the work specified in this Section.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Manufacturer's product data.
- B. Detailed shop drawings of the fence and gate layout, including installation details of the fencing, posts, gates, hardware and accessories.
- C. If PVC coated fencing is indicated or specified, manufacturer's color chart of available colors and physical sample of the selected color.

1.3 DELIVERY AND HANDLING

- A. Deliver materials with the manufacturer's tags and labels intact.
- B. Handle and store materials in such a manner that will avoid damage.

1.4 TRANSPORTATION AND HANDLING

Provide transportation and handling in accordance with the requirements of Section 01610 of these Specifications.

1.5 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.
 - 1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM A121 – Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
 - 3. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 4. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 5. ASTM A392 – Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
 - 6. ASTM A510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 - 7. ASTM A653 – Standard Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 8. ASTM A824 – Standard Specification for Metallic Coated Steel Marcellised Tension Wire for Use with Chain-Link Fence
 - 9. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled Carbon, Structural, High-Strength, Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra-High Strength.
 - 10. ASTM F567 – Standard Practice for Installation of Chain-Link Fence

11. ASTM F626 – Standard Specification for Fence Fittings
 12. ASTM F668 – Standard Specification for PolyvinylChloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric
 13. ASTM F900 – Standard Specification for Industrial and Commercial Swing Gates
 14. ASTM F934 – Standard Specification for Standard Colors for Polymer-Coated Chain-Link Fence Materials
 15. ASTM F1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
 16. ASTM F1664 – Standard Specification for PolyvinylChloride (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence
 17. ASTM F1665 – Standard Specification for PolyVinylChloride (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence
- B. Chain Link Fence Manufacturers Institute (CLFMI): CLFMI Publication, “Standards for Chain Link Fence Installation”.
- C. Federal Specifications:
1. RR-F-191/2C – Fencing, Wire and Post, Metal (Chain Link Fence Gates) (Detail Specification)
 2. RR-F-191/4C – Wire and Post, Metal (Chain Link Fence Accessories) (Detail Specification)

PART 2 PRODUCTS

2.1 GENERAL

- A. Fencing shall include fabric, covering, framework, barbed wire and supporting arms, concrete footings, gates, hardware and all appurtenances and accessories required for a complete installation.
- B. Height of fence shall be as shown on the Drawings.

2.2 MATERIALS

A. Chain Link Fence Fabric

1. Zinc Coated Steel Fence Fabric: Fabric shall be 9 gage wire, woven to 2-inch squares and shall be galvanized in accordance with ASTM A392, Class 2.
2. PVC Coated Steel Fence Fabric
 - a. Fabric shall be 9 gage wire, woven to 2-inch squares.
 - b. Fabric shall be PVC coated in accordance with ASTM F 668.
 - c. Color shall be selected by the Owner from manufacturer's standard colors as specified in ASTM F934.
3. Selvages: Selvages shall be twisted and barbed at top and bottom when barbed wire is used; knuckled at both selvages when barbed wire is not used; unless otherwise indicated.

B. Pipe Framework for Zinc Coated Steel Fabric: Posts and rails shall be standard weight galvanized steel pipe conforming to ASTM F1083. Sizes and weights shall be as follows:

1. End and corner posts shall be 2.875-inches outside diameter galvanized pipe weighing not less than 5.79 pounds per linear foot for end, corner and gate posts for gates 6-feet wide and smaller. Gate posts for gate leaves from 6-feet to 13-feet shall have an outside diameter of 4.00-inches, weighing not less than 9.11 pounds per linear foot.
2. Line Post: Line posts shall be 2.375-inches outside diameter galvanized pipe weighing not less than 3.65 pounds per linear foot.
3. Rails and braces shall be 1.660-inches outside diameter galvanized pipe weighing not less than 2.27 pounds per linear foot. Posts shall include galvanized bolted fittings to properly secure rails and braces to posts.

C. Pipe Framework for PVC Coated Fabric

1. Posts and rails shall be vinyl-clad steel with color coated polyvinylchloride chemically bonded to standard weight ASTM F1083 galvanized steel pipe by electrostatically applied powder coating process. Protective vinyl coating thickness shall be 10 to 14 mils.
2. Color shall match fence fabric color.

D. Tension Wire: Tension wire for top and bottom edge support of fence fabric shall be

No. 7 gage steel zinc-coated wire conforming to ASTM A824 with a minimum tensile strength of 80,000 psi. For PVC coated fabric, provide tension wire coated with PVC, conforming to ASTM F1664. PVC coating shall match fence fabric in color.

E. Post Caps and Fittings

1. Post caps and fittings shall be manufacturer's standard, pressed steel or malleable iron post caps, fittings and accessories, meeting the requirements of ASTM F626 and Federal Specification RR-F-191/4C, galvanized for zinc coated steel fencing, and PVC coated by the thermal-fusion-bond process in color matching posts for PVC coated fencing.
2. Post caps shall be designed to fit securely over the posts to exclude water and to carry the top rail and extension arms, where indicated.
3. All other required fittings and hardware shall be provided to fasten to the pipe posts or concrete in the manner indicated.

F. Truss Rods: Truss rods shall be alloy steel rods conforming to ASTM A510, with a minimum tensile strength of 80,000 psi and a minimum diameter of 5/8-inch. Provide rods with threaded ends and self-tightening galvanized turnbuckles and anchor plates. Secure anchor plates to posts and gate frames by welding.

G. Stretcher Bars: Provide one-piece lengths equal to the full fabric height with a minimum cross section of 1/4-inch by 3/4-inch. Provide one stretcher bar for each gate and end post and two for each corner and pull post.

H. Stretcher Bar Bands: Provide galvanized heavy pressed steel or malleable iron bands with a minimum cross section of 1/8-inch by 3/4-inch, spaced not more than 15-inches on center, to secure stretcher bars to end, corner, pull and gate posts.

I. Accessories

1. Provide miscellaneous materials and accessories, including nuts and bolts, clips, tie wires (9 gage), anchors and fasteners as required for a complete installation. All items shall be galvanized in accordance with ASTM A123 or ASTM A153 as applicable.
2. Accessories for PVC fencing shall be vinyl coated or painted to match color of fence fabric.

J. Barbed Wire Extension Arms

1. Barbed wire extension arms shall be pressed steel conforming to ASTM A653, hot-dip galvanized after fabrication, complete with provision for anchorage to end, corner or pull posts and for attaching three rows of barbed wire to each arm.

2. Arms shall be 45 degree angle or vertical as shown on the Drawings, for three strands of barbed wire. Arms shall be integral with post top weather cap. Intermediate arms shall have holes for passage of top tension wire.
 3. Arms shall be capable of withstanding 300 pounds downward pull at outermost end of arm without failure.
 4. Extension arms for PVC coated fencing shall be vinyl-coated or painted to match color of fence fabric.
- K. Barbed Wire: Barbed wire shall be double strand 12 gage steel wire, with 14 gage barbs in a 4-point pattern on 5-inch centers. Wire shall conform to ASTM A121, Type Z (galvanized). For PVC coated fabric, provide barbed wire coated with PVC conforming to ASTM F1665. PVC coating shall match fence fabric in color.
- L. Gates: Gates shall be swinging type or sliding type as shown on the Drawings, furnished complete with all hardware and accessories as required for a complete installation.
1. Gate Frames: Gate frames shall be fabricated from zinc-coated steel pipe members to match zinc-coated fencing having a minimum outside dimension of 1.90-inches and weighing not less than 2.72 pounds per linear foot.
 2. Fabrication: Conform to the applicable requirements of ASTM F900, Federal Specification RR-F-191/2C and the following:
 - a. Assemble gates by welding or with fittings and rivets for rigid connections. Use same fabric as for fence. Install fabric with stretcher bars at vertical edges and wire ties at top and bottom edges. Attach stretcher bars to gate frames at not more than 15-inches on center. Attach hardware with rivets or by other means that will provide security against removal or breakage.
 - b. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.
 - c. Provide diagonal cross bracing consisting of minimum ½-inch diameter adjustable length truss rods on gates where necessary to provide frame rigidly without sag or twist.
 - d. For PVC coated fencing, gate components shall be PVC coated or painted in color matching fence fabric.
 3. Gate Hardware
 - a. Swinging Gates: Provide gate hinges, latch, stop and keeper for each gate leaf, conforming to the applicable requirements of ASTM F900 and Federal Specification RR-F-191/2C. Provide latch with provision for locking gate with a padlock.

- b. Sliding Gates: Provide manufacturer's standard rubber tired rollers and roller track for floor supported sliding gates. Include intermediate rollers or casters where required to prevent gate sag or deflection. Provide locking device and padlock eyes as part of latch for locking gate with a padlock,
- M. Pipe Sleeves: Furnish pipe sleeves for fence post embedment in concrete curbs, barriers and walls. Pipe sleeves shall be fabricated from steel pipe conforming to ASTM A53 and galvanized in accordance with ASTM A123, sized to receive and support fence posts.

2.3 GROUND RODS

Ground Rods: Shall be 5/8-inch in diameter and 8 feet in length unless shown otherwise on the Drawings. Ground rods shall be galvanized steel. Galvanizing shall have a minimum coating of 2 oz. per square foot in accordance with ASTM A153.

2.4 CONCRETE AND GROUT

Provide concrete and non-shrink grout for footings for fence posts. Concrete shall be 3000 psi and shall be furnished in accordance with the requirements of Section 03055, Concrete.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Fence installation shall not be started before final grading is completed, with finish grade elevations established, unless otherwise directed by the Engineer.
- B. Install fencing and gates in accordance with the requirements of ASTM F567 and CLFMI Standards for Chain Link Fence Installation. Site fabricate as required to complete the installation.
- B. Excavation: Drill holes of diameters and spacings shown, for post footings in firm, undisturbed or compacted soil.
 - 1. If not shown on the Drawings or stated in the Specifications, excavate holes to the minimum diameters as recommended by fence manufacturer.
 - 2. Unless otherwise indicated, excavated hole depths shall be approximately 3-inches lower than the post bottom, with bottom of posts set not less than 36-inches below the surface when in firm, undisturbed soil.
 - 3. If rock is encountered near the surface, drill into rock at least 12-inches for line posts and at least 18-inches for end, pull corner, and gate posts. Drill hole at least 1-inch greater diameter than the largest dimension for the post to be placed. If rock is below soil overburden, drill to full depth required. Penetration into rock

need not exceed the minimum depths specified above.

- C. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes and moisten soil prior to placing concrete.
 - 1. Center and align posts in holes 3-inches above bottom of excavation.
 - 2. Place concrete around posts in a continuous pour and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations. Allow concrete to attain at least 75 percent of its minimum 28 day compressive strength, but in no case sooner than five days after placement, before rails, tension wires, barbed wire or fabric is installed. Do not stretch and tension fabric and wires and do not hang gates until the concrete has attained its full design strength.
 - 3. Trowel finish tops of footings and slope or dome to direct water away from posts. Extend footings for gate posts to the underside of bottom hinge. Set keeps, stops, sleeves and other accessories into concrete as required.
 - 4. Keep exposed concrete surfaces moist for at least seven days after placement or cure with membrane curing materials or other acceptable curing methods.
 - 5. Grout-in posts set into sleeved holes, concrete construction or rock excavations with non-shrink Portland cement grout or other acceptable grouting material.
 - 6. Distance between end, pull and corner or angle post assemblies shall not exceed 500 feet for chain link fence in a straight line; and 250 feet for chain link fence in a curved line.
- D. Top Rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer.
- E. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- F. Tension Wire: Install tension wires by weaving through the fabric and tying to each post with not less than 6 gage galvanized wire or by securing the wire to the fabric.
- G. Chain Link Fabric: Pull fabric taut and tie to posts, rails and tension wires. Install fabric on security side of fence and anchor to framework so that fabric remains in tension after pulling force is released.
- H. Repair damaged coatings in the shop or during field erection by recoating with manufacturer's recommended repair compound, applied per manufacturer's directions.

- I. Stretcher Bars: Thread through or clamp to fabric 4-inches on center and secure to posts with metal bands spaced 15-inches on center.
- J. Barbed Wire: Install three parallel wires on each extension arm. Pull wire taut and fasten securely to each extension arm. Extension arms shall overhang the outside of the fence at a 45 degree angle. The topmost strand of barbed wire shall be 12-inches above the top of the fabric.
- K. Tie Wires: Use U-shaped wire appropriate for the diameter of pipe. Attach pipe and fabric firmly with tie wire ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
- L. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- M. Gates
 - 1. Gate assemblies shall be of the length, height and type as shown on the Drawings.
 - 2. Gate frames shall be welded or with fittings and rivets and shall be coated after assembly. The fabric shall be the same as that used for the fence and shall be rigidly attached to the frames. Frames shall be suitably braced and trussed.
 - 3. Three strands of barbed wire shall be provided on the top of the gate.
 - 4. Swinging gate assemblies shall be furnished with offset hinges to allow the gate to swing open 180 degrees. Provide a minimum of 3 hinges on each gate leaf.
 - 5. Gate assemblies shall be provided with a combination spring latch and plunger rod of approved design for padlocking.
 - 6. Furnish designated gates with galvanized steel stop/hold open device with catch or plunger rod of standard manufacture and approved design.
- N. Electrical Ground
 - 1. Wherever a power line carrying more than 600 volts passes over the fence, a ground rod shall be installed. The ground rod shall be installed at the nearest point directly below the point of crossing. Where possible, the rod shall be driven into the ground for a full eight feet of penetration. In rocky soil, the rod may be driven slanted so as to provide 18-inches of cover at the tip.
 - 2. If solid rock is encountered, two ground rods may be installed at the nearest post on each side of the power line crossing where soil conditions will permit. A length of No. 6 bare copper seven strand wire shall be attached between the fence and the ground rod with suitable clamps.

3.2 REMOVAL AND REPLACEMENT OF EXISTING FENCE AND GATES

- A. The Contractor shall notify the Engineer prior to removal of any existing fence and gates and present to the Engineer a plan for maintaining the security of the facility or property in the absence of a complete fencing system.
- B. No existing fencing shall be removed unless approved by the Engineer.
- C. Fence, gates and components that have been removed shall be protected by the Contractor until reinstalled. Fence and gates shall be reinstalled when directed by the Engineer. Any fence, gates or components that have been damaged by the Contractor during removal and storage that are considered unsuitable for reinstallation by the Engineer shall be removed from the site and new fence, gates and components shall be furnished and installed by the Contractor at no cost to the Owner.
- D. New fencing, gates and components shall match the existing fence.

3.3 CLEANING

Perform cleaning during installation of the work and upon completion of the work. Remove from site all debris and equipment. Repair all damage resulting from chain link fence system installation.

END OF SECTION

SECTION 02900

TREES, PLANTS, AND GROUND COVERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Conduct tree survey as described herein.
- B. Provide trees, plants, and ground covers as shown and specified. The work includes:
 - 1. Soil preparation.
 - 2. Trees, plants, and ground covers.
 - 3. Planting mixes.
 - 4. Mulch and planting accessories.
 - 5. Existing tree care.
 - 6. Filling around trees to remain.
 - 7. Maintenance.
- C. Related Work Specified Elsewhere:
 - 1. Section 02000 - Site Work
 - 2. Section 02200 - Earthwork
 - 3. Section 02933 – Seeding and Sodding

1.2 QUALITY ASSURANCE

- A. Comply with Section 02000 requirements.
- B. Plant names indicated, comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.
- C. Comply with sizing and grading standards of the latest edition of "American Standard for Nursery Stock". A plant shall be dimensioned as it stands in its natural position.
- D. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project for a minimum of 2 years.
- E. Stock furnished shall be at least the minimum size indicated. Larger stock is acceptable, at no additional cost, and providing that the larger plants will not be cut back to size indicated. Provide plants indicated by two measurements so that only a maximum of 25% are of the minimum size indicated and 75% are of the maximum size indicated.

- F. Provide "specimen" plants with a special height, shape, or character of growth. Tag specimen trees or shrubs at the source of supply. The Engineer will inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, provide sufficient photographs of the proposed specimen plants for approval.
- G. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size, and variety.

Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work.
- H. Provide and pay for material testing. Testing agency shall be acceptable to the Engineer. Provide the following data:
 - 1. Test representative material samples proposed for use.
 - 2. Topsoil:
 - a. pH factor.
 - b. Mechanical analysis.
 - c. Percentage of organic content.
 - d. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.
 - 3. Peat Moss:
 - a. Loss of weight by ignition.
 - b. Moisture absorption capacity.

1.3 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Tree survey in AutoCAD Civil 3D format.
- B. Mulch samples.
- C. Planting accessories samples.
- D. Certification for topsoil source and pH value; peat moss and plant fertilizer.
- E. Material test reports.
- F. Upon plant material acceptance, submit written maintenance instructions recommending procedures for maintenance of plant materials.
- G. Plant material record drawings:

- H. Legibly mark drawings to record actual construction.
- I. Indicate horizontal and vertical locations, referenced to permanent surface improvements.
- J. Identify field changes of dimension and detail and changes made by Change Order.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.
- B. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Spray deciduous plants in foliage with an approved "Anti-Desiccant" immediately after digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival, the certificate shall be filed with the Engineer. Protect all plants from drying out. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss, or in a manner acceptable to the Engineer. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.
- C. Cover plants transported on open vehicles with a protective covering to prevent wind burn.
- D. Provide dry, loose topsoil for planting bed mixes. Frozen or muddy topsoil is not acceptable.

1.5 PROJECT CONDITIONS

- A. Work notification: Notify Engineer at least 7 working days prior to installation of plant material.
- B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations.
- C. A complete list of plants, including a schedule of sizes, quantities, and other requirements is shown on the drawings. In the event that quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall govern.
- D. The irrigation system may be installed prior to planting. Locate, protect, and maintain the irrigation system during planting operations. Repair

irrigation system components, damaged during planting operations, at Contractor's expense.

1.6 WARRANTY

- A. Warrant plant material to remain alive and be in healthy, vigorous condition for a period of 1 year after completion and acceptance of each contract item as listed in bid package.

Inspection of plants will be made by the Engineer at completion of planting.

- B. Replace, in accordance with the drawings and specifications, all plants that are dead or, as determined by the Engineer, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacement(s) is at Contractor's expense. Warrant all replacement plants for 1 year after installation.
- C. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.
- D. Remove and immediately replace all plants, as determined by the Engineer to be unsatisfactory during the initial planting installation.

PART 2 - PRODUCTS

2.1 TREE SURVEY

- A. The Contractor shall be responsible for flagging and surveying all trees within and 20-feet outside of the limits of disturbance as provided in the construction documents, except pines, with a minimum diameter at breast height (DBH) of six inches as defined in Section 158 of the City of Atlanta Tree Protection Ordinances. All pines with a minimum DBH of 12 inches shall be flagged and surveyed. Furthermore, all trees surveyed that are dead or diseased, as determined by the city forester or city arborist shall be noted on the survey plan.
- B. The tree survey shall be provided to the Engineer for approval in AutoCAD Civil 3D format with each tree represented as a point with DBH, species, and location provided. The survey shall also include topographic information at two-foot contour intervals (minimum) and shall show all existing buildings and structures, driveways and parking areas, drainage structures, water detention areas, and utilities.

2.2 MATERIALS

Plants: Provide plants typical of their species or variety; with normal, densely-developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage.

- A. Dig balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock". Cracked or mushroomed balls are not acceptable.
- B. Container-grown stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.
 - 1. No plants shall be loose in the container.
 - 2. Container stock shall not be pot bound.
- C. Provide tree species that mature at heights over 25 feet with a single main trunk. Trees that have the main trunk forming a "Y" shape are not acceptable.
- D. Plants planted in rows shall be matched in form.
- E. Plants larger than those specified in the plant list may be used when acceptable to the Engineer.
- F. If the use of larger plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.
- G. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size designated in the plant list.
- H. No pruning wounds shall be present with a diameter of more than 1" and such wounds must show vigorous bark on all edges.
- I. Evergreen trees shall be branched to the ground.
- J. Shrubs and small plants shall meet the requirements for spread and height indicated in the plant list.
 - 1. The measurements for height shall be taken from the ground level to the height of the top of the plant and not the longest branch.
 - 2. Single stemmed or thin plants will not be accepted.

3. Side branches shall be generous, well-twiggged, and the plant as a whole well-bushed to the ground.
4. Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries.

2.3 ACCESSORIES

- A. Topsoil for Planting Beds and Tree Pits: Fertile, friable, natural topsoil of loamy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH 6.0 and 6.8.
 1. Topsoil that has been stripped and stockpiled on site shall be the topsoil to be utilized on this project. Provide additional topsoil if necessary.
 2. Provide topsoil free of substances harmful to the plants which will be grown in the soil. Provide 12-inches of topsoil in all plant beds and tree pits.
 3. Planting mixture shall be composed of four (4) parts topsoil, two (2) parts peat moss, one (1) part sharp sand and one (1) part well rotted manure, mixed together thoroughly, and worked into existing soil.
- B. Peat Moss: Brown to black in color, weed and seed free granulated raw peat or baled peat, containing not more than 9% mineral on a dry basis.

Provide ASTM D2607 sphagnum peat moss with a pH below 6.0 for ericaceous plants.
- C. Fertilizer:
 1. Plant Fertilizer Type "A": Commercial type approved by the Engineer, containing 5% nitrogen, 10% phosphoric acid, and 5% potash by weight. 1/4 of nitrogen in the form of nitrates, 1/4 in form of ammonia salt, and 1/2 in form of organic nitrogen.
 2. Plant Fertilizer Type "B": Approved acid-base fertilizer.
- D. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.
- E. Premium grade shredded pine bark 3/4" to 1-1/2" diameter. Furnish in - 3 cu. ft. bags or bulk.
- F. Water: Free of substances harmful to plant growth. Hoses or other methods of transportation furnished by Contractor.
- G. Stakes for Staking: Hardwood, 2" x 2" x 8'-0" long.

- H. Stakes for Guying: Hardwood, 2" x 2" x 36" long.
- I. Guying/Staking/Wire: No. 10 or 12, gage galvanized wire.
 - 1. For large trees (4" caliper and greater) use turnbuckles and heavier gage wire as indicated below
 - a. Stakes for Staking: Hardwood, 4"x 4"x 8'-0" long.
 - b. Guying/Staking/Wire: No. 6 or 8 gage galvanized wire.
 - 2. Turnbuckles: Galvanized steel of size and gage required to provide tensile strength equal to that of the wire. Turnbuckle openings shall be at least 3".
- J. Staking and Guying Hose: Two ply, reinforced garden hose not less than 1/2" inside diameter.
- K. Tree Wrap: Standard waterproofed tree wrapping paper, 2-1/2" wide, made of 2 layers of crepe kraft paper weighing not less than 30 lbs. per ream, cemented together with asphalt. Tree wrap shall be removed at 12 months after installation of plant material.
- L. Twine: Two-ply jute material.
- M. Soil Separator: Rot resistant polypropylene filter fabric, water permeable, and unaffected by freezing and thawing.
- N. Drainage Tile: ASTM F405 corrugated polyethylene drainage tubing, perforated.
- O. Drainage Fill: AASHTO M43 #6(3/8" to 3/4") clean uniformly graded stone or gravel.

PART 3 - EXECUTION

3.1 INSPECTION

Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.

3.2 CARE OF TREES TO REMAIN

- A. Minor fills of 6" or less: Fill with topsoil; hand grade to required finish grade elevation.
- B. Moderate fills of 12" or less: Place layer of 3/4" to 1-1/2" stone or gravel on grade. Provide aggregate depth 1/2 of fill height, minimum of 3". Cover drainage fill with polypropylene filter fabric or 1" thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevations.

- C. Deep fills over 12": Place layer of 3/4" to 1-1/2" stone or gravel on grade. Extend drainage fill to within 2" of required finish grade. Cover drainage fill with polypropylene filter fabric or 1" thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Provide tile drainage system and vents as indicated.
- D. Deep fills over 18": Place 4" depth of 1" to 2" stone or gravel fill on grade, extending three (3) feet beyond the outer branch drip line around tree branch perimeter. Cover drainage fill with polypropylene filter fabric or 1" thickness straw choke. Place 1" to 2" stone or gravel fill around tree trunk, extending to within 2" of required finish grade elevation. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Do not place earth fill in contact with tree trunk, maintain 18" diameter of drainage fill exposed at finish grade.

3.3 PREPARATION

- A. Time of planting:
 - 1. Evergreen material: Plant evergreen materials between September 1 and November 1 or in spring before new growth begins. If project requirements require planting at other times, plants shall be sprayed with anti-desiccant prior to planting operations.
 - 2. Deciduous material: Plant deciduous materials in a dormant condition. If deciduous trees are planted in-leaf, they shall be sprayed with an anti-desiccant prior to planting operation.
 - 3. Planting times other than those indicated shall be acceptable to the Engineer.
- B. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.
- C. Locate plants as indicated or as approved in the field after staking by the Contractor. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until alternate plant locations have been selected.
- D. Excavate circular plant pits with vertical sides, except for plants specifically indicated to be planted in beds. Provide shrub pits at least 12" greater than the diameter of the root system and 24" greater for trees. Depth of pit shall accommodate the root system. Provide undisturbed tamped down topsoil to hold root ball at nursery grade as shown on the drawings. Remove excavated materials from the site.
- E. Provide pre-mixed planting mixture for use around the balls and roots of the plants consisting of planting topsoil and 1/2 lb. plant fertilizer Type "A" for each cu. yd. of mixture.

- F. Provide pre-mixed ground cover bed planting mixture consisting of 3 parts planting topsoil to 1 part peat moss and 1/2 lb. plant fertilizer Type "A" per cu. yd. Provide beds a minimum of 12" deep. If slopes are greater than 4 to 1 increase depth to 18".
- G. Provide pre-mixed planting mixture for use around the balls and roots of ericaceous plants consisting of 2 part planting topsoil to 1 part sphagnum peat moss and 1/2 lb. plant fertilizer Type "B" per cu. yd. of mixture.

3.4 INSTALLATION

- A. Set plant material in the planting pit to proper grade and alignment. Set plants upright, plumb, and faced to give the best appearance or relationship to each other or adjacent structure. Set plant material 2"-3" above the finish grade. No filling will be permitted around trunks or stems. Backfill the pit with planting mixture. Do not use frozen or muddy mixtures for backfilling. Form a ring of soil around the edge of each planting pit to retain water.

- B. After balled and burlapped plants are set, muddle planting soil mixture around bases of balls and fill all voids.

Remove all burlap, ropes, and wires from the tops of balls of trees and remove entirely from all other plant material.

- C. Space ground cover plants in accordance with indicated dimensions. Adjust spacing as necessary to evenly fill planting bed with indicated quantity of plants. Plant to within 12" of the trunks of trees and shrubs within planting bed and to within 6" of edge of bed.

NOTE: Provide drainage tiles if Contractor encounters standing water in planting pits or conditions warrant.

- D. Drain tile: Install drainage tile with perforations down and closed joints, firmly bedded in minimum 4" layer of granular fill material. Provide full bearing for each pipe section. Provide continuous slope in the direction of flow.
 - 1. Provide collars and couplings for all in-line joints and elbows for all corners and changes in direction.
 - 2. Provide unperforated run out pipe. Extend drainage tile to out fall indicated and make connection.
 - 3. Obtain required inspections and perform testing before backfilling. Remove obstructions, replace damaged components, and retest system as required. Provide a satisfactory free flowing drainage tile system.
 - 4. Place drainage fill over drain piping after satisfactory testing and acceptance. Compact drainage fill layers not exceeding 6" in loose

depth. Exercise care to avoid damage or displacement of installed piping.

- a. Completely cover drain lines to width of at least 6" each side of pipe and above top of pipe to within 18" of finish grade.
 - b. Provide soil separator over drainage fill prior to topsoil fill. Overlap a minimum of 6".
5. Install topsoil fill over compacted drainage fill. Compact topsoil fill in layers not exceeding 6" in loose depth. Extend topsoil fill to indicated finish grade elevations. Slope topsoil fill away from building.

E. Mulching:

1. Mulch tree and shrub planting pits and shrub beds with required mulching material 3" deep immediately after planting. Thoroughly water mulched areas. After watering, rake mulch to provide a uniform finished surface.
2. Mulch ground cover beds with mulch 2" deep immediately after planting.

F. Wrapping, guying, staking:

1. Inspect trees for injury to trunks, evidence of insect infestation, and improper pruning before wrapping.
2. Wrap trunks of all trees spirally from bottom to top with specified tree wrap and secure in place.
 - a. Overlap 1/2 the width of the tree wrap strip and cover the trunk from the ground to the height of the second branch.
 - b. Secure tree wrap in place with twine wound spirally downward in opposite direction, tied around the tree in at least 3 places in addition to the top and bottom. Wrapping and twine to be removed 12 months after installation of plant material.
3. Staking/Guying:
 - a. Stake/guy all trees immediately after lawn seeding or sodding operations and prior to acceptance. When high winds or other conditions which may effect tree survival or appearance occur, the Engineer may require immediate staking/guying.
 - b. Stake deciduous trees under 3" caliper. Stake evergreen trees under 8'-0" tall.
 - c. Guy deciduous trees over 3" caliper. Guy evergreen trees over 8'-0" tall.
 - d. All work shall be acceptable to the Engineer.

G. Pruning:

1. Prune branches of deciduous stock, after planting, to balance the loss of roots and preserve the natural character appropriate to the

particular plant requirements. In general, remove 1/4 to 1/3 of the leaf bearing buds, proportion shall in all cases be acceptable to the Engineer. Remove or cut back broken, damaged, and unsymmetrical growth of new wood.

2. Multiple leader plants: Preserve the leader which will best promote the symmetry of the plant. Cut branches flush with the trunk or main branch, at a point beyond a lateral shoot or bud at a distance of not less than 1/2 the diameter of the supporting branch. Make cut on an angle.
3. Prune evergreens only to remove broken or damaged branches.

H. Care of existing trees:

1. Selectively prune existing trees in designated areas, under Engineer's direction. Remove sucker shoots, dead, rubbing, and damaged branching.
2. Fertilize designated existing trees with 2 to 3 lbs. of Type "A" plant fertilizer per inch of trunk diameter, for trees less than 6" diameter and 3 to 5 lbs. for trees greater than 6" diameter.
 - a. Fertilize in early spring before growth begins or in late October.
 - b. Fertilize at 2' to 3' on center in a triangular pattern to a depth of 18" within the dripline.
 - c. Injection or drilling fertilization methods, when used, shall be acceptable subject to Engineer's approval.
3. Water existing trees every 2 weeks until acceptance. Water thoroughly with a fine mist sprinkler head soaker hose or hose at a low flow rate over the entire drip line area as required to allow water to penetrate to a depth of 12" to 18".

I. Tree relocation:

Transplant trees designated for relocation to locations shown on the drawings. Prune, dig, ball and burlap, move and plant in accordance with specified tree planting requirements.

3.5 MAINTENANCE

- A. Maintain plantings until completion and acceptance of the entire project.
- B. Maintenance shall include pruning, cultivating, weeding, watering, and application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.
 1. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.
 2. Tighten and repair guy wires and stakes as required.
 3. Remove tree wrapping and twine 12 months after installation of plant material.

4. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.
5. Water trees, plants, and ground cover beds within the first 24 hours of initial planting, and not less than twice per week until final acceptance.

3.6 ACCEPTANCE

- A. Inspection to determine acceptance of planted areas will be made by the Engineer, upon Contractor's request. Provide notification at least 10 working days before requested inspection date.

Planted areas will be accepted provided all requirements, including maintenance, have been complied with and plant materials are alive and in a healthy, vigorous condition.

- B. Upon acceptance, the Owner will assume plant maintenance.

3.7 CLEANING

Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soils, debris, and equipment. Repair damage resulting from planting operations.

+++ END OF SECTION +++

SECTION 02933

SEEDING AND SODDING

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this Section consists of furnishing all labor, equipment and material required to place topsoil, seed, commercial fertilizer, agricultural limestone and mulch material, including seedbed preparation, harrowing, compacting and other placement operations on graded earthen areas as described herein and/or shown on the Drawings.
- B. Seeding operations shall be conducted on all newly graded earthen areas not covered by structures, pavement or sidewalks; all cleared or grubbed areas which are to remain as finish grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be seeded according to these Specifications.
- C. The Work shall also include temporary seeding operations to stabilize earthen surfaces during construction or inclement weather and to minimize stream siltation and erosion. Temporary seeding shall be performed at the times and locations as directed by the Engineer.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following information shall be submitted:

- A. Prior to seeding operations, labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirements of this Section.
- B. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from the State University Agricultural Extension Services or other certified testing laboratory.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Wood cellulose fiber mulch shall be manufactured by Weyerhaeuser Company or Conway Corporation.

2.2 MATERIALS AND CONSTRUCTION

A. Topsoil

1. Utilizing designated stockpiles or borrow areas on site, the Contractor shall place a minimum of 6 inches of topsoil over all graded earthen areas and over any other areas to be seeded. Sources of topsoil shall be approved by the Engineer prior to disturbance.
2. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than 1/2 inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life.
3. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, sandy loam or a combination thereof. The pH shall range from 5.5 to 7.0. Topsoil shall contain not less than 5 percent nor more than 20 percent, by weight, of organic matter as determined by loss on ignition of oven dried samples to 65 Degrees C.

B. Seed

1. Seed shall be hulled common Bermuda (Cynodon Dactylon) guaranteed by the dealer to be 98% minimum purity and 90% minimum germination and certified free of giant strain Bermuda.
2. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
3. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet or otherwise damaged in transit or storage.
4. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Engineer, samples of seed may be taken for check against the grower's analysis.

5. Species, rate of seeding, fertilization and other requirements are shown in Table 02933-1 at the end of this Section.

C. Fertilizer and Liming Materials

1. Fertilizer and liming materials shall comply with applicable state, local and federal laws concerned with their production and use.
2. Commercial fertilizer shall be a ready mixed material and shall be equivalent to the grade or grades specified in Table 02933-1. Container bags shall have the name and address of the manufacturer, the brand name, net weight and chemical composition.
3. Agricultural limestone shall be a pulverized limestone having a calcium carbonate content of not less than 85 percent by weight.
4. Fertilizer shall be a complete fertilizer, the content of which shall meet the following minimum requirements: 10% nitrogen, 10% phosphoric acid, 10% potash, available materials. Fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in original unopened containers bearing the manufacturer's statement of guarantee.
5. Ammonium Nitrate shall be a standard brand and shall be delivered to the site in original unopened containers. It shall contain not less than 33 1/3% Nitrogen.

D. Mulch Material

1. All mulch materials shall be air dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.
2. Mulch shall be composed of wood cellulose fiber, straw or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch blowing equipment.
3. Straw mulch shall be partially decomposed stalks of wheat, rye, oats or other approved grain crops.
4. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum or other approved standing field crops.

E. Mulch Binder

1. Mulch on slopes exceeding 3 to 1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be non toxic to plant life and shall be acceptable to the Engineer.
2. Emulsified asphalt binder shall be Grade SS 1, ASTM D977. Cutback asphalt binder shall be Grade RC 70 or RC 250.

- F. Inoculants for Legumes: All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen fixing bacteria that is adapted to the particular seed involved.

- G. Water: Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.
- H. Sod
1. Sod shall be living, growing sod of Bermuda hybrids "Tifway 419" or Tifgreen 328". This includes sod which is dormant during the cold or dry season and capable of renewing growth after the dormant period. All sod shall be obtained from approved sources. The presence of weeds or other noxious growth or any other foreign material which may be detrimental to the proposed planting will be cause of rejection. At least 85% of the plants in the sod shall be composed of the designated variety of Bermuda grass.
 2. The Engineer shall be notified of sources before it is harvested. Approval of such sources shall not be construed as an acceptance of the material. The sod will be subject to inspection while it is being planted and any material which has been permitted to dry out excessively or exposed to extreme heat, or which is not viable, will be rejected.
 3. In the harvesting of the sod, grass more than 3-inches tall shall be mowed to a height of 3-inches, raked and removed before sod cutting begins. The sod shall be cut into square or rectangular sections which may vary in length, but which shall be of uniform width and thickness, and shall have at least ½-inch of soil adhering firmly to the roots. Care shall be exercised at all times to retain the soil on the roots of the sod during the process of cutting, transporting and planting. Sod shall be transplanted within 24 hours from the time it is harvested. All sod stored shall be kept moist, shall be protected from exposure to the air and sun and from freezing, and shall not be stored for more than 10 days. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected.

PART 3 - EXECUTION

3.1 SECURING AND PLACING TOPSOIL

- A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Engineer.
- B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed the product will be homogeneous in nature and will conform to the requirements of these Specifications.

- C. All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen or its residue and any other refuse which will hinder or prevent growth.
- D. In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such material shall be removed from the topsoil or if required by the Engineer, the pit shall be abandoned.
- E. Before placing or depositing topsoil upon any areas, all improvement within the area shall be completed, unless otherwise approved by the Engineer.
- F. The areas in which topsoil is to be placed or incorporated shall be prepared before securing topsoil for use.

3.2 SEEDBED PREPARATION

- A. Before liming, fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line from unsightly variation, bumps, ridges and depressions and all detrimental material, roots and stones larger than 3 inches in any dimension shall be removed from the soil.
- B. Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 2 inches with a weighted disc, tiller, pulvimixer or other equipment, until the surface is smooth and in a condition acceptable to the Engineer.
- C. If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be cultivated for seeding.
- D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition, as determined by the Engineer.

3.3 FERTILIZATION AND LIMING

- A. Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown in Table 02933-1 at the end of this Section.
- B. Fertilizer shall be spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of 1/2 inch.
- C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The

seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.

- D. Agricultural limestone shall be thoroughly mixed into the soil according to the rates in Table 02933-1. The specified rate of application of limestone may be reduced by the Engineer if pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Engineer for adjustment in rates.
- E. It is the responsibility of the Contractor to make one application of a maintenance fertilizer according to the recommendations listed in Table 02933-1.
- F. On the approved grade, spread 20 lbs. per 1,000 sq. ft. of 10 10 10 fertilizer into top 3-inches, hand rake and smooth. The surface shall be brought to finish grade requirements, allowance being made for settlement. Finish grades shall be smooth and free from hollows or other inequalities.
- G. Three weeks after construction of lawns add ammonium nitrate at the rate of 5 lbs. per 1000 sq. ft. of lawn area, and thoroughly water in.

3.4 SEEDING

- A. Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seeding shall be performed during the dates shown in Table 02933-1 unless otherwise approved by the Engineer. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation.
- B. Seed shall be uniformly sown by any approved mechanical method suitable for the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder or approved mechanical power drawn seed drills. Hydro seeding and hydro mulching may be used on steep embankments, provided full coverage is obtained. Care shall be taken to adjust the seeder for seedings at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.
- C. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- D. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen fixing inoculant in accordance with the manufacturer's mixing instructions.

- E. Italian rye grass (*Lolium Multiflorum*) shall be evenly seeded with a mechanical spreader at the rate of 5 lbs. per 1000 sq. ft. of area, lightly rake, suitably compact and thoroughly water. Before planting the permanent lawn, the rye shall be thoroughly scarified in a manner to incorporate it into the top three inches of the ground.
- F. The planting of bermuda grass shall be done only within the season extending from April 15 to August 1.

3.5 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.
- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:

Mulch Type	Application Rate
Wood Cellulose Fiber	1,400 pounds/acre
Straw	4,000 pounds/acre
Stalks	4,000 pounds/acre

- C. These rates may be adjusted at the discretion of the Engineer at no additional cost to the Owner, depending on the texture and condition of the mulch material and the characteristics of the seeded area.
- D. The Contractor shall cover structures, poles, fence and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
- E. Mulch and binder shall be applied by suitable blowing equipment at closely controlled application rates in a manner acceptable to the Engineer.

3.6 WATERING

- A. The Contractor shall be responsible for maintaining the proper moisture content of the soil to insure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank truck or sprinklers in such a way to prevent erosion, excessive runoff and overwatered spots.

3.7 MAINTENANCE

- A. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris and excess material and the premises shall be left in a neat and orderly condition.
- B. The Contractor shall maintain all seeded areas without additional payment until final acceptance of the work by the Owner, and any regrading, refertilizing, reliming, reseeding or remulching shall be done at the Contractor's own expense. Seeding work shall be repeated on defective areas until a satisfactory uniform stand is accomplished. Damage resulting from erosion, gulleys, washouts or other causes shall be repaired by filling with topsoil, compacting and repeating the seeding work at the Contractor's expense.
- C. Contractor's guarantee of one (1) year shall also cover a fully rooted stand of grass.

TABLE 02933-1
SEEDING REQUIREMENTS

Area	Sowing Season	Species	Seed	Rates per 1,000 Square Feet		
				Fertilizer	Limestone	Maintenance**
Flat to rolling terrain with slopes less than 3:1	3/1 to 4/15	Rebel II Turf-Type Tall Fescue	6-8 lbs.	30 lbs. 6-12-12	200 lbs.	10 lbs. 10-10-10
	9/1 to 11/15	Rebel II Turf-Type Tall Fescue	6-8 lbs.	30 lbs. 6-12-12	200 lbs.	15 lbs. 10-10-10
Embankments with slopes greater than 3:1	3/1 to 6/1	Crownvetch* Kentucky 31 Fescue Weeping Lovegrass	1 lb. 2 lbs. 1/4 lb.	30 lbs. 6-12-12	200 lbs.	10 lbs. 0-20-20
	8/1 to 11/1	Crownvetch* Kentucky 31 Fescue Annual Ryegrass	1 lb. 2 lb. 2 lb.	30 lbs. 6-12-12	200 lbs.	10 lbs. 0-20-20

* Requires inoculation

** Maintenance fertilizer shall be applied in early spring following initial establishment of cover

END OF SECTION

SECTION 03030

REPAIR AND REHABILITATION OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to repair or rehabilitate, as required, all existing concrete shown or indicated in the Contract Documents as being repaired or rehabilitated.
2. CONTRACTOR shall repair all damage to new concrete construction as specified in this Section except for repair Work specified in Section 03055, Concrete.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with or before repair and rehabilitation of concrete.
2. Notify other contractors in advance of repair and rehabilitation of concrete Work to provide them with sufficient time for installing and coordinating items included in their contracts that must be installed in conjunction with repair and rehabilitation of concrete Work.

C. Related Sections:

1. Section 01600, General Material and Equipment Requirements
2. Section 03055, Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
2. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
3. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.
4. ASTM D3574, Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams.

5. ASTM G109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Product Data: Information on all products proposed for use, including manufacturer's brochures, technical data, specifications, and other applicable data.
- B. Informational Submittals: Submit the following:
 1. Manufacturer's Instructions: Manufacturer's recommended procedures for installing materials proposed for use.
- C. Special Procedure Submittals: When requested by ENGINEER, submit information on methods for supporting during demolition and repair Work existing structures, pipes, and other existing facilities affected by the Work.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling of Materials:
 1. Conform to Section 01600, General Material and Equipment Requirements, and this Section.
 2. Clearly mark on containers manufacturer's name and label, name or title of material, manufacturer's stock number, and date of manufacture.
 3. Handle materials carefully to prevent inclusion of foreign matter.
 4. Do not open containers or mix components until necessary preparatory Work has been completed and application Work is to start immediately.
- B. Storage of Materials:
 1. Conform to Section 01600, General Material and Equipment Requirements, and this Section.
 2. Store only approved materials at the Site.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. All repair and rehabilitation materials that can or will come into contact with potable water or that will be treated to become potable shall be listed in ANSI/NSF 61.

2.2 REPAIR MORTAR

- A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects.
- B. Products and Manufacturers: Provide one of the following:
1. SikaTop 122 Plus, SikaTop 123 Plus, or SikaTop 126 Plus, by Sika Corporation.
 2. DuralTop Gel, DuralTop Flowable Mortar by Euclid Chemical Company.
 3. Or equal.
- C. Materials:
1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

Physical Property	Value	ASTM Standard
Minimum Compressive Strength at One Day	2,000 psi	C109
Minimum Compressive Strength at 28 Days	6,000 psi	C109
Minimum Bond Strength at 28 Days	1,800 psi	C882*
* Modified for use with repair mortars.		

2. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.

2.3 EXPANSION JOINT REPAIR SYSTEM

- A. System Description: Joint repair system shall consist of two components: an epoxy resin adhesive and hypalon sheeting
- B. Products and Manufacturers: Provide one of the following:
1. Sikadur Combiflex, by Sika Corporation.
 2. Or equal.
- C. Materials:
1. Epoxy Resin Adhesive: Provide two-component epoxy resin as follows:
 - a. Component "A" shall be modified epoxy resin of epichlorohydrin bisphenol-A type containing suitable

- viscosity control agents and pigments. Resin shall not contain butyl glycidyl ether.
 - b. Component "B" shall be primarily a reaction product of selected amine blend with epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents, pigments, and accelerators.
2. Hypalon Sheeting:
- a. Provide sheeting of hypalon rubber, perforated along bonding edge to provide mechanical key. Sheeting shall have ability to be vulcanized with hydrocarbon solvent for adhesion to an epoxy resin adhesive.
 - b. Provide sheeting in 12-inch width with thickness of 40 mils.
 - c. Sheeting shall be able to be lapped or seamed by heat or by anaromatic hydrosolvent strip.
 - d. Provide sheeting with removable center expansion strip.

2.4 REPAIR OF EXPOSED REINFORCING STEEL

- A. System Description: System for repair of exposed reinforcing steel shall consist of two components: an initial application of corrosion inhibitor and subsequent application of protective slurry mortar.
- B. Corrosion Inhibitor:
 - 1. Corrosion inhibitor shall penetrate the hardened concrete surface and form a protective layer on reinforcing steel.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sika FerroGard 903, by Sika Corporation.
 - b. Or equal.
 - 3. Corrosion inhibitor shall:
 - a. Not change the substrate's color, appearance, or texture.
 - b. Penetrate independently of orientation (horizontal, vertical, overhead) at rate up to 1/10 to 4/5 inches per day, depending on density of concrete, measured using secondary neutron mass spectroscopy.
 - c. Form on reinforcing steel a protective layer of high integrity of at least 100 angstroms thickness, measured using x-ray photon spectroscopy and secondary ion mass spectroscopy.
 - d. Demonstrate reduction in corrosion currents after treatment as determined using cracked beam corrosion tests of concrete, as adapted from ASTM G109.
 - e. Be capable of reducing active corrosion rates by at least 65 percent. Reduction shall be demonstrated by project references and an independent corrosion engineer using linear polarization resistance.

- f. Penetrate up to three inches in 28 days, measured using secondary neutron mass spectroscopy.
 - C. Protective Slurry Mortar:
 - 1. Material shall be two-component, polymer-modified, cementitious waterproofing and protective slurry mortar. Provide two coats at coverage of 50 square feet per gallon per coat.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikatop Seal 107, by Sika Corporation.
 - b. Or equal.

2.5 CRACK INJECTION MATERIALS

- A. Crack Repair System:
 - 1. Hydrophobic Polyurethane Chemical Grout:
 - a. Provide hydrophobic polyurethane that forms a flexible gasket.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) SikaFix HH LV, by Sika Chemical Company.
 - c. Or equal. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.
 - d. Minimum elongation of 250 percent in accordance with ASTM D3574.
 - e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.
 - 2. Hydrophilic Acrylate-Ester Resin:
 - a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume by at least 50 percent when in contact with water.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Multigel 850, manufactured by
 - 2) BBZ USA, Inc.
 - 3) Or equal

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the repair Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation:

1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting all laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.
2. Wetting Procedure: Where repair concrete, shotcrete, or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:
 - a. Surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.
 - b. Prevent concrete from drying until after repair is completed. Re-wet surfaces not yet repaired using water sprays at least a daily; should more than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.
 - c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.
3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

3.3 INSTALLATION, GENERAL

- A. Construction Tolerances: Shall be as specified in Section 03055, Concrete, except as specified in this Section and elsewhere in the Contract Documents.
- B. Care shall be taken to fully consolidate repair material, completely filling all portions of space to be filled.
- C. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.
- D. Curing:
 1. Curing of repair mortar and non-shrink grout shall be in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.

2. Curing of other materials shall be in accordance with requirements of Section 03055, Concrete.

3.4 REPAIR OF SURFACE DEFECTS

- A. Surface defects are depressions in a concrete surface that do not extend all the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement. For spalls that result from corroded reinforcing steel or other embedment refer to Article 3.7 of this Section.
- B. Preparation: Perform the following in addition to requirements of Article 3.2 of this Section:
 1. Remove by chipping all loose, damaged concrete to sound material.
 2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify ENGINEER.
 3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.
- C. Repair Material:
 1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.
 2. Perform, with repair mortar, repairs of surface defects in concrete normally in contact with water or soil, and interior surfaces of structures that contain water.
 3. Repair of other surface defects may be by applying repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.5 PATCHING OF HOLES IN CONCRETE

- A. For holes larger than 1/2inch diameter or equivalent area of hole, refer to the Drawings for reinforcing details.
- B. Fill openings less than four inches in their least dimension with non-shrink epoxy grout in accordance with Section 03055, Concrete.
- C. Openings greater than four inches and less than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with non-shrink grout in accordance with Section 03055, Concrete.

- D. Openings greater than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class B concrete in accordance with Section 03055, Concrete.

3.6 REPAIR OF LINED HOLES

- A. This Article applies to openings with embedded material over all or a portion of inside surface of hole. Where indicated on the Drawings, remove embedded materials and repair the hole in accordance with Article 3.5 of this Section, as modified in this Article 3.6.
- B. Where embedded material is allowed to remain, remove embedded material to at least two inches into the hole, as measured from the plane surface of concrete wall or slab, as applicable. Embedded material left in place shall be roughened or abraded for proper bonding to repair material. Completely remove substances that interfere with proper bonding.
- C. Completely remove embedded items not securely and permanently anchored into concrete.
- D. Completely remove embedded items larger than 12 inches in their smallest dimension. In lieu of removing the embedded item, where reinforcing is required as shown or indicated in the Contract Documents, weld reinforcing to embedded item to remain, provided embedded item to remain is composed of metal to which reinforcing steel can be welded.

3.7 REPAIR OF DETERIORATED CONCRETE

- A. This Article pertains to deteriorated concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, or damage due to chemical attack. Use repair mortar, as specified in this Article, for repairing deteriorated concrete. Where repaired surface will be subsequently covered with plastic liner material, coordinate finishing with requirements for installing plastic liner material.
- B. Surface Preparation: In addition to requirements of Article 3.2 of this Section, perform the following surface preparation:
 - 1. Remove loose, broken, softened, and acid-contaminated concrete by abrasive blasting and chipping to sound, uncontaminated concrete.
 - 2. Upon completion of removal of deteriorated concrete, notify ENGINEER in writing. Allow two weeks for ENGINEER to evaluate the surface, perform testing for acid contamination if required, determine if additional concrete shall be removed, and to develop special repair details (if any) required. Should

ENGINEER determine that additional concrete be removed to reach sound, uncontaminated concrete, allow another two-week period for further evaluation and testing following the additional removal.

3. Surface preparation shall conform to recommendations of repair mortar manufacturer.
4. Repair and rehabilitate isolated areas of exposed reinforcing bars in accordance with Article 3.4 of this Section. If extensive areas of reinforcing steel are uncovered after removal of deteriorated concrete, ENGINEER will determine the repair methods required.

C. Repair Mortar Placing:

1. Conform to manufacturer's recommended procedures for mixing and placing repair mortar.
2. After initial mixing of repair mortar, addition of water is not allowed.
3. Minimum Thickness:
 - a. Install repair mortar to not less than minimum thickness recommended by manufacturer, and not less than 1/2-inch.
 - b. Where removal of deteriorated concrete results in repair thickness of less than minimum required thickness to return to original concrete surface in isolated areas totaling less than ten percent of total repair surface area, remove additional concrete to obtain at least the required minimum thickness.
 - c. Where surface area with repair thickness less than minimum required thickness exceeds ten percent of total repair area, notify ENGINEER.
 - d. Provide repair mortar so that minimum cover over existing reinforcing steel is two inches. Do not place repair mortar creating locally raised areas.
 - e. Where transitioning to or from wall surfaces not requiring repair, do not feather-out repair mortar at transition. Instead, form the transition by saw cutting a score line to not less than minimum required repair mortar depth and chip out concrete to the saw cut line. Do not cut or otherwise damage reinforcing steel.
4. Place repair mortar to an even, uniform plane to restore concrete member to its original surface. Out-of-plane tolerance shall be such that the gap between 12-inch long straight edge and repair mortar surface does not exceed 1/8-inch, and gap between a four-foot long straight edge and repair mortar surface shall not exceed 1/4-inch. Tolerances specified in this paragraph apply to straight edges placed in any orientation at any location.

D. Finishing:

1. Provide smooth, steel trowel finish to repair mortar.

2. When completed, there shall be no sharp edges. Provide exterior corners, such as at penetrations, one-inch radius. Interior corners shall be square, except corners to receive plastic lining which shall be made with two-inch fillet in repair mortar.

3.8 REPAIR OF EXPANSION JOINTS

- A. Surface Preparation: Remove the following from surfaces to be repaired: laitance, foreign material, and unsound concrete. Remove by chipping, abrasive blasting, or hydro blasting. Additional surface preparation, if required, shall be as recommended by expansion joint repair system manufacturer.
- B. Installation: Installation shall be as recommended by expansion joint repair system manufacturer.

3.9 REPAIR OF EXPOSED REINFORCING

- A. Remove, by abrasive blasting or hydro blasting, all corrosion, foreign materials, and unsound concrete from area to be repaired.
- B. Surface shall be visually dry before applying corrosion inhibitor. Liberally apply corrosion inhibitor to achieve coverage of 100 square feet per gallon in two or more coats, by allowing corrosion inhibitor to soak into substrate. Time between coats shall be the longer of: one hour, or as recommended by corrosion inhibitor manufacturer. Apply using rollers, brushes, or hand-pressure spray equipment.
- C. After applying final coat of corrosion inhibitor, minimum cure time of 24 hours is required.
- D. Provide high-pressure wash to surfaces to be repaired to remove filmy residue from corrosion inhibitor.
- E. For mortar coating, conform to Paragraphs 3.7.C, 3.7.D, 3.7.E of this Section.

3.10 CRACK INJECTION

- A. Examine areas under which injection Work will be installed and locate cracks that require injection. Identify and inject cracks greater than 0.010-inch wide in structures that retain or contain water, wastewater, or similar liquid.
- B. Install injection material in accordance with crack injection manufacturer's requirements.

- C. After injecting and curing, verify that injected material penetrated the crack adequately and that there is no visible leakage through the crack. After injecting, if crack continues to leak, re-inject crack at no additional cost to OWNER until structure is watertight.
- D. If proper penetration of crack cannot be achieved, submit to ENGINEER a proposed alternate approach for modifying the specified injection procedure to properly seal the crack. In new concrete and in concrete cracked as a result of CONTRACTOR's operations, perform modifications to crack injection procedure and fully repair the crack without additional cost to OWNER or extension of the Contract Times.

3.11 SITE QUALITY CONTROL

- A. OWNER will employ and pay for services of testing laboratory for Site quality control testing. ENGINEER will direct the number of tests and specimens required, including providing necessary materials for making and facility for storing test specimens. CONTRACTOR shall make standard compression test specimens as specified in this Section under the observation of ENGINEER. CONTRACTOR shall provide:
 - 1. Necessary assistance required by ENGINEER.
 - 2. All labor, material, and equipment required, including rods, molds, thermometer, curing in heated storage box, and all other incidentals required, subject to approval by ENGINEER.
 - 3. All necessary storage, curing, and transportation required for testing.
 - 4. CONTRACTOR will be charged for cost of additional testing and investigation, if any, for Work performed that is not in accordance with the Contract Documents or is otherwise defective.
- B. Site Tests of Cement-based Grouts and Repair Mortar:
 - 1. Obtain compression test specimens during construction from first placement of each type of mortar or grout, and at intervals thereafter as selected by ENGINEER, to verify compliance with the Contract Documents. Specimens will be made by ENGINEER or ENGINEER's representative.
 - 2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed in accordance with ASTM C109. Set of three specimens will be made for each test. Tests will be made at seven days, 28 days, and additional time periods as deemed appropriate by ENGINEER.
 - 3. Material, already placed, failing to conform to the Contract Documents, is defective.
- C. Repair Concrete: Repair concrete shall be tested as required in Section 03055, Concrete.

END OF SECTION

SECTION 03055

CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
2. The Work includes:
 - a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
 - b. Fabricating and placing reinforcing, including ties and supports.
 - c. Design, erection, and removal of formwork.
 - d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
 - e. Providing openings in concrete as required to accommodate Work under this and other Sections, and work under other contracts.
 - f. Providing openings in concrete to accommodate the Work under other contracts and building into the concrete all items such as sleeves, frames, anchor bolts, inserts and all other items required to be embedded under other contracts.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work as a prime responsibility of the Contractor.
2. Notify other contractors in advance of placing concrete to provide other contractors with sufficient time for installing items included in their contracts that are to be installed in the concrete Work.

C. Classifications of Concrete:

1. Class "A" concrete shall attain 4,500 psi compressive strength at 28 days, shall be steel reinforced and includes the following:
 - a. Foundations.
 - b. Walls.
 - c. Slabs on grade.
 - d. Beams.
 - e. Elevated concrete floors.

- f. Columns.
- 2. Class “B” concrete shall attain 3,000 psi compressive strength at 28 days, shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
 - a. Concrete fill.
 - b. Duct banks.
 - c. Unreinforced encasements.
 - d. Curbs and gutters.
 - e. Sidewalks.
 - f. Thrust blocks.
 - g. Fence post footings
 - h. Pavement Patches
 - i. Mud Slabs
- 3. Class “C” concrete shall attain 1,500 psi compressive strength at 28 days, shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
 - a. Concrete encasement for pipe.
 - b. Other locations as required.

D. Related Sections:
Section 05051, Anchor Systems.

1.2 REFERENCES

Standards referenced in this Section are:

- 1. ACI 224R, Control of Cracking in Concrete Structures.
- 2. ACI 301, Specifications for Structural Concrete for Buildings.
- 3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
- 4. ACI 305R, Specification for Hot Weather Concreting.
- 5. ACI 306R, Cold Weather Concreting.
- 6. ACI 309R, Guide for Consolidation of Concrete.
- 7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
- 8. ACI 347, Guide to Formwork for Concrete.
- 9. ACI SP-66, ACI Detailing Manual.
- 10. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- 11. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
- 12. ASTM C33/C33M, Specification for Concrete Aggregates.
- 13. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- 14. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

15. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
16. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
17. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
18. ASTM C150/C150M, Specification for Portland Cement.
19. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
20. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
21. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
22. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
23. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
24. ASTM C579, Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
25. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

26. CRD-C 572, U. S. Army Corps of Engineers Specification for Polyvinylchloride Waterstops.
27. CRSI 1MSP, Manual of Standard Practice.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:

1. Contractor shall employ, at its own expense an independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
 - a. Testing agency shall meet the requirements of ASTM E329.
 - b. Submit a written description of the proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities and equipment, and other information which may be requested by the City DWM.
 - c. Submit certification that the testing facility meets the requirements of ASTM E329.
2. Materials and installed Work may require testing and retesting as directed by the Contractor at any time during the progress of the Work. Contractor shall allow free access to material stockpiles and facilities at all times. Testing and retesting of rejected materials and installed Work, shall be done at the Contractor's expense.

3. Testing for concrete field quality control as specified under Paragraph 3.07 of this Specification, shall also be performed by the Contractor's testing laboratory.
4. Qualifications of Water-Reducing Admixture Manufacturer:
 - a. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Contractor shall furnish copy of manufacturer's quality assurance handbook to document the existence of the program. Manufacturer shall maintain a concrete testing laboratory which has been approved by the Cement and Concrete Reference Laboratory at the Bureau of Standards, Washington, D.C.
 - b. Provide a qualified concrete technician employed by the admixture manufacturer to assist in proportioning the concrete for optimum use of the admixture. The concrete technician, when requested, shall advise on proper addition of the admixture to the concrete and on adjustment of the concrete mix proportions to meet changing job site conditions.
5. Test for Concrete Materials:
 - a. Submit written reports to the City DWM, for each material selected and tested, prior to the start of Work. Provide the Project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each materials, and test results. Indicate acceptability of materials for intended use.
 - b. Have the testing laboratory run a sample load of the design mix and make a minimum of 12 test cylinders. Then have the laboratory do cylinder breaks at 3, 7, 21 and 28 days and plot an average strength curve for the mix design. Submit curve to the City DWM prior to any concrete pour.
6. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
7. Perform the following testing on each trial batch:
 - a. Aggregate gradation for fine and coarse aggregates.
 - b. Slump.
 - c. Air content.
 - d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
8. Submit for each trial batch the following information:
 - a. Project identification name and number (if applicable).
 - b. Date of test report.
 - c. Complete identification of aggregate source of supply.

- d. Tests of aggregates for compliance with the Contract Documents.
- e. Scale weight of each aggregate.
- f. Absorbed water in each aggregate.
- g. Brand, type, and composition of cementitious materials.
- h. Brand, type, and amount of each admixture.
- i. Amounts of water used in trial mixes.
- j. Proportions of each material per cubic yard.
- k. Gross weight and yield per cubic yard of trial mixtures.
- l. Measured slump.
- m. Measured air content.
- n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the Contract Documents.
- B. Samples: Submit samples of materials as specified and as otherwise may be requested by the City DWM, including names, sources and descriptions
- C. Action Submittals: Submit the following:
 - 1. Shop Drawings Submit to the City DWM for the Project record the following:
 - a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
 - b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests. Production of concrete to comply with specified requirements is the responsibility of the Contractor. Submit the testing laboratory's average strength curve from the design mix proportions of the proposed materials
 - c. Concrete placement drawings showing the location and type of all joints.
 - d. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.

- e. Submit notarized certification of conformance to referenced standards to the City DWM and a copy of the batch plant's most recent scale calibration.
 - f. Delivery Tickets: Furnish to Contractor and if requested by City DWM copies of all delivery tickets for each load of concrete delivered to the site. Provide items of information as specified in ASTM C94, Section 14.
 - 2. Product Data:
 - a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 - 3. Samples:
 - a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER or the City DWM, including names, sources, and descriptions.
- D. Informational Submittals: Submit the following:
 - 1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
 - 2. Site Quality Control Submittals:
 - a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transportation, Delivery, and Handling:
 - 1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
 - 2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
 - 3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
 - 4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
- B. Storage:
 - 1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective,

- waterproof covering. Provide for adequate air circulation or ventilation under cover.
2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.
 3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
 4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type II.
 1. Use Portland cement made by a qualified, acceptable manufacturer and produced by not more than one plant.
 2. Do not use cement which has deteriorated because of improper storage or handling.
 3. Type I cement is NOT PERMITTED.
- B. Aggregates: ASTM C33/C33M.
 1. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
 2. Coarse Aggregate:
 - a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter.
 - b. Coarse aggregate shall comply with the following:
 - 1) Crushed stone, processed from natural rock or stone.
 - 2) Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed.
 - c. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.
- C. Water: Water shall be clean, free from injurious amounts of oils, acids, alkalis, organic materials or other substances that may be deleterious to concrete or steel..
- D. Admixtures: Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer's printed instructions. Do not use admixtures, which have not been incorporated and tested in the accepted mixes.

1. Air-Entraining Admixture: ASTM C260.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Daravair as manufactured by Grace Construction Products.
 - 2) MB-VR as manufactured by Master Builders Company.
 - 3) Sika AER as manufactured by Sika Chemical Corporation.
 - 4) Air Entraining Agent as manufactured by W. R. Meadows.
 - 5) Or equal.
2. Air entrainment shall be required for all concrete used on this project.
- E. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - a. Proportion all concrete with non-air entraining, normal setting, water-reducing, aqueous solution of a modification of the salt of polyhydroxylated organic acids. The admixture shall not contain more chloride ions than are contained in municipal drinking water. Provide one of the following:
 - 1) WRDA-86 as manufactured by Grace Construction Products.
 - 2) Pozzoloth by Master Builders Company.
 - 3) Plastocrete 161 as manufactured by Sika Chemical corporation
 - 4) Or equal.
- F. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.
- G. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
- H. Use only admixtures that have been tested and approved in the mix designs. Do not use calcium chloride or admixtures containing chloride ions.

2.2 CONCRETE MIX

- A. General:
 1. Normal weight: 145 pounds per cubic foot.
 2. Use air-entraining admixture in all concrete. Provide not less than four percent, nor more than eight percent, entrained air for concrete exposed to freezing and thawing, and provide from three to five percent entrained air for other concrete.
- B. Proportioning and Design of Class "A" Concrete Mix:
 1. Minimum compressive strength at 28 days: 4,500 psi.
 2. Maximum water-cement ratio by weight: 0.45.
 3. Minimum cement content: 564 pounds per cubic yard.
- C. Proportioning and Design of Class "B" Concrete Mix:
 1. Minimum compressive strength at 28 days: 3,000 psi.
 2. Maximum water-cement ratio by weight: 0.50.

3. Minimum cement content: 517 pounds per cubic yard.
- D. Slump Limits:
1. Proportion and design mixes to result in concrete slump at point of placement of not less than one inch and not more than four inches.
 2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.
- E. Adjustment of Concrete Mixes:
1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
 2. Submit for ENGINEER's approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
 3. Implement adjusted mix designs only after ENGINEER's approval.
 4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

- A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.
- B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.
- C. Unexposed Concrete Surfaces: Material to suit project conditions.
- D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.
- E. Form Ties:
1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
 2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
 3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.

4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.
- B. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
 1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
 2. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
- C. Adhesive Dowels:
 1. Dowels:
 - a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
 2. Adhesive:
 - a. For requirements for adhesive, refer to Section 05051, Anchor Systems.

2.5 RELATED MATERIALS

- A. Waterstops:
 1. PVC Waterstops:
 - a. Manufacturers: Provide products of one of the following:
 - 1) W.R. Meadows, Inc.
 - 2) Greenstreak Plastic Products Company.
 - 3) Or equal.
 - b. Waterstops shall comply with CRD-C 572. Do not use reclaimed or scrap material.
 - c. Minimum Thickness: 3/8-inch.
 - d. Provide waterstops with minimum of seven ribs equally spaced at each end on each side with the first rib located at the edge. Each rib shall be minimum 1/8-inch in height.
 - e. Construction Joints: Waterstops shall be six-inch wide flat-strip type.
 - f. Expansion Joints: Waterstops shall be nine-inch wide centerbulb type.
 2. Hydrophilic Waterstops:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Gasket, by BBZ USA, Inc.
 - 2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.

- 4) Or equal.
 - b. Hydrophilic waterstop materials shall be bentonite-free and shall expand by minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
 - c. Waterstop material shall be composed of resins and polymers that absorb water and cause a completely reversible and repeatable increase in volume.
 - d. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
 - e. Select material in accordance with manufacturer's recommendations for type of liquid to be contained.
 - f. Minimum cross-sectional dimensions: 3/16-inch by 3/4-inch.
 - g. Location of hydrophilic waterstops shall be as shown or indicated on the Drawings, or where approved by ENGINEER.
 - h. Hydrophilic Sealant: Shall adhere firmly to concrete, metal, and PVC in dry or damp condition and be indefinitely elastic when cured.
 - 1) Products and Manufacturers: Provide one of the following:
 - a) Duroseal Paste, by BBZ USA, Inc.
 - a) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
 - a) Hydrotite, by Greenstreak Plastic Products Company.
 - a) Or equal.
- B. Membrane-Forming Curing Compound: ASTM C309, Type I.
- C. Epoxy Bonding Agent:
- 1. Two-component epoxy resin bonding agent.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
 - b. Eucopoxy LPL, by the Euclid Chemical Company.
 - c. Or equal.
- D. Epoxy-Cement Bonding Agent:
- 1. Three-component blended epoxy resin-cement bonding agent.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sika Armatec 110 EpoCem, by Sika Corporation.
 - b. Duralprep A.C., by Euclid Chemical Company.
 - c. Or equal.

2.6 GROUT

- A. Non-shrink Grout:
 - 1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
 - 2. Minimum 28-day Compressive Strength: 7,000 psi.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. NS Grout by Euclid Chemical Company.
 - b. Set Grout by Master Builders, Inc.
 - c. NBEC Grout by Five Star Products, Inc.
 - d. Or equal.
- B. Epoxy Grout:
 - 1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
 - 2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Euco High Strength Grout, by Euclid Chemical Company.
 - b. Sikadur 42, Grout Pak, by Sika Corporation.
 - c. Five Star Epoxy Grout, by Five Star Products, Inc.
 - d. Or equal.
- C. Grout Fill:
 - 1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
 - 2. Proportion and mix grout fill as follows:
 - a. Minimum Cement Content: 564 pounds per cubic yard.
 - b. Maximum Water-Cement Ratio: 0.45.
 - c. Maximum Coarse Aggregate size: 1/2-inch, unless otherwise indicated.
 - d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

- A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.

- B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.
- C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.
- D. Removing Formwork:
 - 1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
 - 2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
 - 3. Removal time for formwork is subject to ENGINEER's acceptance.
 - 4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

- A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.
- B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.
- C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
 - 1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
 - 2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.
- D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last

leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

- E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, as shown on the Drawings.
- F. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.
- G. Joints:
 - 1. Provide construction joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure.
 - 2. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
 - 3. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.
- H. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting diagrams, templates, and instructions provided under other Sections and, when applicable, other contracts for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete in accordance with Section 09900 Painting.
- I. Adhesive Dowels:
 - 1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
 - 2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Holes shall not be more than 1/4-inch greater than nominal bar diameter, and hole depth shall not be less than twelve times nominal bar diameter. Hammer-drill holes. Cored holes are not allowed.
 - 3. Embedment depths shall be based on concrete compressive strength of 2,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.
5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
7. Twist dowels during insertion into a partially filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

- A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.
- B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.
- C. Concrete Placing:
 1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
 2. Do not begin placing concrete until work of other trades affecting concrete is completed.
 3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
 4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
 5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
Complete concrete placing within 90 minutes of addition of water to the dry ingredients.
- D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-

spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.

- E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
 - 1. In hot weather comply with ACI 305R.
 - 2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

- A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.
- B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
- C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.
- D. Repair, removal, and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

- A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

- A. Formed Finish:
 - 1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.

2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

3.8 FIELD QUALITY CONTROL

A. Site Testing Services:

1. CONTRACTOR shall employ independent testing laboratory to perform field quality control testing for concrete. ENGINEER will direct where samples are obtained.
2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
3. CONTRACTOR shall provide curing and necessary cylinder storage.

B. Quality Control Testing During Construction:

1. Perform sampling and testing for field quality control during concrete placing, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
 - c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
 - d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
 - e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
 - f. Compression Test Specimens:
 - 1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
 - 2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
 - g. Compressive Strength Tests:
 - 1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
 - 2) Concrete that does not comply with strength requirements will be considered as defective Work.

- h. Submit test results from certified by testing laboratory to ENGINEER within 24 hours of completion of test.
- i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
 - 1) Testing of Adhesive Dowels: CONTRACTOR will employ testing agency to perform field quality control testing of drilled dowel installations. After adhesive system manufacturer's recommended curing period and prior to placing connecting reinforcing, proof-test for pullout ten percent of adhesive dowels installed. Adhesive dowels shall be tensioned to 60 percent of specified yield strength. Where dowels are located less than six bar diameters from edge of concrete, ENGINEER will determine tensile load required for test. If one or more dowels fail, retest all dowels installed for the Work. Dowels that fail shall be reinstalled and retested at CONTRACTOR's expense.

END OF SECTION

SECTION 05051

ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 318, Building Code Requirements for Structural Concrete.
2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
4. ACI 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
5. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
6. ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
7. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
8. ASTM A276, Specification for Stainless Steel Bars and Shapes.
9. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
10. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
11. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
12. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
13. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.

14. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
15. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
16. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
17. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
18. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
19. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).
20. FS A-A-1923A, Concrete Expansion Anchors.
21. FS A-A-1925A, Shield, Expansion (Nail Anchors).
22. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).
23. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
24. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
25. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
26. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.
27. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
2. Post-installed Anchor Installer:
 - a. Mechanical Anchors: Installer shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.
 - b. Adhesive Anchors: Installation shall be performed by personnel certified under an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchors Installer Certification Program, or equivalent. Description of equivalent programs shall be submitted for ENGINEER's approval and shall be accepted by the building official having jurisdiction.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

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1. Shop Drawings:
 - a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
 2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
 - b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.
 3. Samples:
 - a. Representative Samples of anchor systems proposed for use in the Work. Review will be for type and finish only. Compliance with all other requirements is CONTRACTOR's exclusive responsibility.
- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
 - b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
 - c. For each adhesive anchor installer, submit ACI/CRSI Adhesive Anchor Installer Certification.
 2. Manufacturer's Instructions:
 - a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
1. Keep materials dry during delivery and storage.
 2. Store adhesive materials within manufacturer's recommended storage temperature range.
 3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. General:

1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.
2. Stainless Steel Nuts:
 - a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
 - b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.
3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
 - a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
 - b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.
 - 1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system

will be installed in an area that is not expected to crack under any and all conditions of design loading.

- 2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.
 - 3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.
 - 5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.
2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
- a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
 - b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
 - c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.
 - d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design

documents and consistent with the design intent expressed in the Contract Documents.

C. Application:

1. Anchor Bolts:
 - a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
 - b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
2. Concrete Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Suitable for use in submerged, intermittently submerged, or buried locations.
 - e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
 - f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
3. Concrete Masonry Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in grout-filled or hollow masonry units.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
4. Concrete Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in concrete.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
 - d. Do not use in submerged, intermittently submerged, or buried locations.
 - e. Suitable for use in overhead applications.
5. Grout-filled Concrete Masonry Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
6. Hollow Concrete Masonry Sleeve Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.

- d. Do not use in exterior locations or locations subject to freezing.
- 7. Drop-in Expansion Anchors:
 - a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use at submerged, intermittently submerged, or buried locations.
 - e. Do not use in exterior locations or locations subject to freezing.
 - f. Suitable for use in overhead applications.
- 8. Concrete Undercut Anchors:
 - a. Use where undercut anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Do not use in submerged, intermittently submerged, or buried locations.
 - d. Do not use in exterior locations or locations subject to freezing.
 - e. Suitable for use in overhead applications.
- 9. Concrete Inserts:
 - a. Use only where shown or indicated in the Contract Documents.
 - b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.
- 10. Drive-In Expansion Anchors:
 - a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use in overhead applications.

2.2 MATERIALS

A. Anchor Bolts:

- 1. Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.
- 2. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.

3. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.
- B. Concrete Adhesive Anchors:
1. General:
 - a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
 2. Products and Manufacturers: Provide one of the following:
 - a. HIT-RE 500 V3 Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
 - b. HIT-HY 200-A and HIT-HY 200-R Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
 - c. SET-XP Adhesive anchoring system, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Adhesive:
 - a. Adhesive system shall use two-component adhesive mix.
 - b. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308, which incorporates the requirements of ACI 355.4-11.
 - c. Adhesives shall have minimum bond strength in accordance with Table 05051-A:

**TABLE 05051-A:
ADHESIVE BOND STRENGTH ^{1,2}**

Bond Strength (psi)					
Rod Diameter	Uncracked Concrete	Cracked Concrete	Dowel Size	Uncracked Concrete	Cracked Concrete
1/2-inch	1670	880	#5	1500	1080
5/8-inch	1670	750	#6	1460	1090
3/4-inch	1670	665	#7	1415	1015
7/8-inch	1525	610	#8	1370	835
1-inch	1360	595	#9	1330	760
-			#10	1560	850
1.25-inch	1070	595	#4	1240	475

Table Notes:

1. Bond strengths listed for hammer-drilled, dry hole.
 2. Bond strengths listed for maximum short term concrete temperature of 130 degrees F and maximum long term concrete temperature of 110 degrees F.
4. Anchor:
 - a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified

proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Concrete Masonry Adhesive Anchors:

1. General:
 - a. Grout-filled concrete masonry adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.
 - b. Hollow concrete masonry adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.
2. Products and Manufacturers: Provide one of the following:
 - a. HIT-HY 70 Hybrid Adhesive Anchor System, by Hilti Fastening Systems, Inc.
 - b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Adhesive:
 - a. Adhesive system shall use two-component adhesive mix.
 - b. Hybrid adhesives shall comply with the following:
 - 1) ASTM D695 compressive yield strength greater than 7,200 psi on a seven-day cure.
 - c. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES AC 58 and ICC-ES AC 60.
4. Anchor:
 - a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.
5. Mesh Screen Tube (for hollow masonry applications):
 - a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.

D. Concrete Wedge Expansion Anchors:

1. General:
 - a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.
2. Products and Manufacturers: Provide one of the following:
 - a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
 - b. Strong Bolt 2 Wedge Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4.
4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 and ACI 350,

Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
 6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.
- E. Grout-filled Masonry Wedge Expansion Anchors:
1. General:
 - a. Grout-filled masonry wedge expansion anchors shall each consist of stud, wedge, nut, and washer.
 2. Product and Manufacturers: Provide one of the following:
 - a. Kwik-Bolt 3 Expansion Anchors, by Hilti Fastening Systems, Inc.
 - b. Wedge-All Wedge Anchors, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Anchors shall be non-bottom bearing type with single-piece steel expansion clip providing 360-degree contact with base material and shall not require oversized holes for installation.
 4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide AISI Type 316 stainless steel anchor, complete with nut and washer, in accordance with ASTM A276 or ASTM A493.
 6. Grout-filled masonry wedge expansion anchors shall have a current ICC Evaluation Service report for use in fully-grouted concrete masonry construction when tested and assessed in accordance with ICC-ES AC01.
- F. Hollow Concrete Masonry Sleeve Expansion Anchors:
1. General:
 - a. Sleeve expansion anchors shall each consist of an externally threaded stud with full length expanding sleeve.
 2. Products and Manufacturers: Provide one of the following:
 - a. HLC Sleeve Anchors, by Hilti Fastening Systems, Inc.
 - b. Dynabolt Sleeve Anchors, by ITW Red Head.
 - c. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1922A. Anchors shall be non-bottom bearing type with single-piece steel expansion sleeve providing 360-degree contact with base material, and shall not require oversized holes for installation.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide expansion anchors complete with nuts and washers, Type 304 stainless steel, in accordance with ASTM A276 or ASTM A493.
- G. Drop-in Expansion Anchors:
1. General:
 - a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
 2. Products and Manufacturers: Provide one of the following:
 - a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
 - b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.
- H. Concrete Undercut Anchors:
1. General:
 - a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.
 2. Products and Manufacturers: Provide one of the following:
 - a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.
 - b. Or equal
 3. Provide concrete undercut expansion anchors in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.
 4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.
 5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.
 7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

- I. Concrete Inserts:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation.
 - b. Cooper B-Line, Inc.
 - c. Anvil International, Inc.
 - d. Or equal.
 - 2. Spot Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
 - 3. Continuous Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
 - 4. Provide inserts with plain finish.
- J. Drive-In Expansion Anchors:
 - 1. General:
 - a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
 - b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 - 3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.
- K. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.
- L. Anti-Seizing Compound:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Pure Nickel Never-Seez, by Bostik.
 - b. Nickel-Graf, by Anti-Seize Technology.
 - c. Or equal.
 - 2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Anchor Bolts:

1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
3. Protect threads and shank from damage during installation and subsequent construction operations.
4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05051-B:

**TABLE 05051-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS ¹**

Bolt Diameter (inch)	F1554 Grade 36				F1554			
	F593 Type 316, Condition A				Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ (lb)	Tension ³ (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ (lb)	Tension ³ (lb)
1/2	6	9	947	1,815	8.5	12.75	1,245	2,393
5/8	7.5	11.25	1,508	2,895	10.5	15.75	1,980	3,810
3/4	9	13.5	2,231	4,290	13	19.5	2,933	5,640
7/8	10.5	15.75	3,080	5,918	15	22.5	4,050	7,793
1	12	18	4,040	7,770	17	25.5	5,318	10,088
1 1/8	13.5	20.25	5,090	9,789	19	28.5	8,930	12,435
1.1/4	15	22.5	6,463	12,429	21	31.5	8,505	15,030

Table Notes:

1. Table is based on ACI 318 and ACI 350, Appendix D, $f'_c = 4000$ psi. Table 05051-B is not applicable to anchor bolts embedded in grouted masonry.
2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 and ACI 350, Appendix D.
3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 and ACI 350, Appendix D.

B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:

1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:

1. Comply with manufacturer's written installation instructions and the following.
2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
9. Limitations:
 - a. At time of anchor installation, concrete shall have compressive strength (f'_c) of not less than 2,500 psi.
 - b. At time of anchor installation, concrete shall have age of not less than 21 days.
 - c. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.

- d. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.
- e. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:

- 1. Comply with expansion anchor manufacturer's written installation instructions and the following:
- 2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
- 3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
- 4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
- 5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.

E. Concrete Undercut Anchors:

- 1. Comply with undercut anchor manufacturer's written installation instructions and the following.
- 2. Protect threads from damage during anchor installation.
- 3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
- 4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
- 5. Insert the anchor by hand until anchor reaches bottom of hole.
- 6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
- 7. Verify that the setting mark is visible on the threaded rod above the sleeve.
- 8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.

F. Concrete Inserts:

- 1. Comply with concrete insert manufacturer's installation instructions.
- 2. Inserts shall be flush with slab bottom surface.

3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
 4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.
- G. Anti-Seizing Compound:
1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
 2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

- A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
1. OWNER will employ testing agency to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
 - a. Testing shall comply with ASTM E488.
 - b. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing, or at ENGINEER's option CONTRACTOR may arrange for testing paid by CONTRACTOR, for all adhesive anchors of same diameter and type installed on the same day as the failed anchor. If anchors installed on the same day as the failed anchor also fail the test, ENGINEER may require retesting of all anchors of the same diameter and type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
 - c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used
 - d. Apply test loads with hydraulic ram.
 - e. Displacement of post-installed anchors shall not exceed $D/10$, where D is nominal diameter of anchor being tested.
- B. Manufacturer's Services:
1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer

demonstrates proper installation procedures for adhesive anchors and adhesive material.

+ + END OF SECTION + +

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SCOPE

- A. WORK INCLUDED: This section covers the work necessary to furnish and install, complete, the structural steel, and shall include all metal parts required for permanent connection of the structural steel.
- B. GENERAL: Like items of materials provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.
- C. RELATED WORK SPECIFIED ELSEWHERE
 - 1. Section 05500 - Miscellaneous Metal
 - 2. Section 09900 - Painting

1.2 SUBMITTALS

- A. Submittals during construction shall be made in accordance with the General Conditions of the Contract Documents.
- B. Shop Drawings, complete with all information and sections.

1.3 QUALITY ASSURANCE

Reference Standards: Comply with the current provisions of the following, except as otherwise indicated:

- A. AISC "Code of Standard Practice for Steel Buildings and Bridges"
- B. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including the "Commentary of the AISC Specification"
- C. AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections of the Engineering Foundation, August 14, 1985; endorsed by the American Institute of Steel Construction and the Industrial Fasteners Institute
- D. AWS Structural Welding Code AWS D1.1-90 and "Standard Qualification Procedure"
- E. ASTM A 36-61, Structural Steel (Rev. A)

- F. ASTM A 53-83, Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- G. ASTM A 325-83, High Strength Bolts for Structural Steel Joints (Rev. C) (*A325M-83)
- H. ASTM A 490-83, Heat-Treated Steel Structural bolts, 150 ksi Minimum Tensile Strength (Rev. A) (*A490M-82)
- I. ASTM A 500-82, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes (Rev. A)
- J. ASTM A 501-83, Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- K. AWS D1.1-90 (83), Structural Welding Code - Steel

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Load structural members in such a manner that they may be transported and unloaded without being excessively stressed, deformed, and otherwise damaged.
- B. Material Storage:
 - 1. Protect structural steel members and packaged materials from corrosion deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground.
 - 2. Do not place materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

1.5 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. ROLLED WIDE FLANGE SHAPES: ASTM A992 unless otherwise shown.
- B. ROLLED PLATES, CHANNELS, ANGLES, AND BARS: ASTM A36 unless otherwise shown.
- C. STRUCTURAL STEEL PIPE: ASTM A53, Grade B.

- D. STRUCTURAL TUBING: ASTM A 500, Grade B. All members shall be furnished full length without splices unless otherwise noted or approved.
- E. BOLTS FOR CONNECTIONS: ASTM A 325 or A 490; use A 325 unless otherwise shown.
- F. WELDED STUDS: Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated on the Drawings and as supplied by Nelson Stud Welding Company, Lorain, OH; Omark Industries, KSM Fastening Systems Division, Seattle, WA, or Portland, OR; or equal.
- G. SHOP PAINT PRIMER: Structural steel shall be cleaned and coated with shop paint primer. Surface preparation and primer shall be as specified in Division 9 - Finishes. Shop prime coat shall be applied within 8 hours after surface preparation.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. MEASUREMENT: The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.
- B. SHOP DRAWINGS: Shop drawings shall conform to AISC recommendations and specifications and shall show all holes, etc., required for other work. Include complete details showing all members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

3.2 FABRICATION:

- A. General
 - 1. Fabricate items of structural steel in accordance with the Drawings, AISC Specifications, and as indicated on the final reviewed shop drawings.
 - 2. Properly mark and matchmark materials for field assembly.
 - 3. Where finishing is required, complete the assembly, including bolting and welding of units, before start of finishing operations.
- B. Connections: Weld or bolt shop connections, as shown. Bolt field connections, except where welded connections or other connections are shown or specified. All connections unless shown otherwise shall develop

full strength of members joined and shall conform to AISC standard connections.

C. Welded Construction:

1. Comply with AWS Current D1.1-90 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work.
2. Submit welder certifications for shop and field welders in triplicate, directly to the Engineer from a recognized testing laboratory, with copies to the Contractor and others as required.
3. Unless otherwise shown, all butt welds are complete penetration.

D. Holes for Other Work: Provide holes as necessary or as indicated for securing other work to structural steel framing, and for the passage of other work through steel framing members. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work. No torch cut holes are permitted.

E. Shop Paint Primer: Apply shop paint primer in accordance with Division 9 - Finishes. Omit at welds, bolts, and where embedded in concrete. Remove all slag from welds before painting.

F. Inspection: Shop inspection may be required by the Owner at his own expense (except for weld inspection as mentioned herein). The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop and inspectors shall be allowed free access to the necessary parts of the works. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but it is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under these Specifications.

3.3 ERECTION

A. General: Comply with the AISC Specifications and Code of Standard Practice, and with specified requirements.

B. Anchor Bolts:

1. Furnish anchor bolts and other connectors required for securing structural steel to in-place work.
2. Furnish templates and other devices for presetting bolts and other anchors to accurate locations.

- C. Setting Bases and Bearing Plates:
 - 1. Clean concrete surfaces of bond reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.
 - 2. Set loose and attached baseplates and bearing plates for structural members on wedges, leveling nuts, or other adjustable devices.
 - 3. Tighten the anchor bolts after the supported members have been positioned and plumbed.
 - 4. Grouting of baseplates shall be as specified in Section 03055. Grout prior to placing loads on structure.

3.4 FIELD ASSEMBLY

- A. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- B. Level and plumb individual members of the structure within specified AISC tolerances. Contractor shall provide and install all temporary bracing required until structure is complete.
- C. Establish required leveling and plumbing measurements on the mean operating temperature of the structure.

3.5 MISFITS AT BOLTED CONNECTIONS

- A. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified and shall select an industry acceptable method to remedy such as:
 - 1. Ream holes that must be enlarged to admit bolts and use oversized bolts.
 - 2. Plug weld misaligned holes and redrill holes to admit standard size bolts.
 - 3. Drill additional holes in the connection, conforming with AISC Standards for bolt spacing, and end and edge distances and add additional bolts.
 - 4. Reject the member containing the misfit, mis-sized, or misaligned holes and fabricate a new member to ensure proper fit.
- B. Mis-sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

3.6 MISFITS AT ANCHOR BOLTS

Any misalignment between anchor bolts and bolt holes in steel members shall be resolved by submitting a request to the Engineer for review. The request shall show an industry acceptable method. Flame cutting to enlarge holes shall not be acceptable.

3.7 GAS CUTTING

Do not use gas cutting torches in the field for correcting fabrication errors in the structural framing, except on secondary members which are not under stress and will be concealed in the finished structure and when approved by the Engineer. Finish gas-cut sections equal to a sheared appearance.

3.8 TOUCHUP PAINTING:

Immediately after section, clean field welds, bolted connections, and abraded areas of the shop paint primer. Apply touchup paint primer by brush or spray which is the same thickness and material as that used for the shop paint.

3.9 QUALITY CONTROL TESTING

A. The Engineer may engage inspectors to inspect bolted connections and welded connections and to perform tests and prepare test reports.

B. Weld Inspection:

1. All butt welds shall be 100 percent tested in accordance with AWS D1.1-90, Part B, Radiographic Testing of Welds.
2. The examination, report, and disposition of radiographs shall be in accordance with Section 6.12 of AWS D1.1-90. Payment of this work shall be included in the lump sum bid. All reports shall be submitted to the Engineer for review prior to completion of the work in this section.
3. Welds that are required by the Engineer to be corrected shall be corrected or redone and retested as directed, at the Contractor's expense and to the satisfaction of the Engineer and/or approved independent testing lab.

C. Finish Painting:

Finish painting of all exposed structural steel shall be as indicated on the Finish Schedule in the Drawings and as specified in Division 9.

END OF SECTION

SECTION 05500

MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 SCOPE

The Contractor shall furnish all labor, materials, equipment and incidentals required and install all miscellaneous metals as shown on the Drawings and specified herein. The miscellaneous metal items include, but are not limited to, the following:

- A. Anchors or anchor bolts unless otherwise specified in other Sections of these Specifications.
- B. Ladders
- C. Grating
- D. Manhole frames and covers
- E. Grates and frames
- F. Manhole steps
- G. Miscellaneous aluminum and steel items

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be submitted:

- A. Manufacturer's data on all materials listed in Part 2 of this Section.
- B. Detail drawings showing sizes of members, method of assembly, anchorage, and connection other members shall be submitted to the Engineer for review before fabrication.

1.3 QUALITY ASSURANCE

Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

- A. ASTM A36 – Standard Specification for Carbon Structural Steel
- B. ASTM A48 – Standard Specification for Grey Iron Castings

- C. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
- D. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- E. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- F. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
- G. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes
- H. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- I. ASTM B241 – Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- J. AWS Specifications for Arc Welding

1.4 COORDINATION

- A. The work of this Section shall be completely coordinated with the work of other Sections.
- B. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- C. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

1.5 FIELD MEASUREMENTS

Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

1.6 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this section, before during and after installation and to protect the work and materials of all other trades.
- B. Delivery and storage: Deliver materials to the jobsite, and store in a safe dry place with all labels intact and legible at the time of installation.

- C. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

1.7 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 ANCHORS, BOLTS AND FASTENING DEVICES

- A. Anchors, bolts and fastening devices shall be furnished as necessary for installation of the work of this Section and shall be designed in accordance with Section 01600.
- B. The bolts used to attach the various members to the anchors shall be the sizes shown or required. Aluminum, iron, steel, and stainless steel shall be attached to concrete by means of stainless steel machine bolts unless otherwise specifically noted.

2.2 ALUMINUM ITEMS

- A. Miscellaneous aluminum shapes and plates shall be fabricated as shown. Angle frames for hatches, beams, grates, etc., shall be furnished complete with welded strap anchors attached. Furnish all miscellaneous aluminum shown but not otherwise detailed. Structural shapes and extruded items shall conform to the detail dimensions on the Drawings within the tolerances published by the Aluminum Association.
- B. Aluminum Ladders
 - 1. Aluminum ladders shall be high strength 6061-T6 aluminum alloy and shall be fabricated to the required height as shown on the Drawings. Rung diameter shall be 1-inch minimum with 12-inches spacing between rungs and 18-inches between ladder rails. Ladder rungs shall have slip resistant surface. Ladders shall have a minimum of 3 pairs of brackets for wall attachment.
 - 2. Ladders shall meet the requirements of OSHA and ANSI standards.
 - 3. Ladders shall be furnished with safety posts to allow for a hand-hold when entering or exiting vaults and other structures.
 - a. Safety posts shall be 48-inches long when fully extended. The safety post shall have a telescoping tubular section that locks automatically when fully extended and a release lever to allow it to be returned to its lowered position.

- b. Safety post shall be manufactured of high strength square tubing.
 - c. All hardware for mounting safety post to ladder shall be type 316 stainless steel and shall be furnished by the post manufacturer.
 - d. Ladder safety post shall be preassembled by the manufacturer and shall be LadderUP Safety Post Model LU-4 as manufactured by the Bilco Company or approved equal.
- C. Aluminum Grating
 - 1. Aluminum grating shall be 1 ¼-inch minimum thickness and shall be designed to support a loading of 150 pounds per square foot.
 - 2. All openings 2-inches or greater in diameter shall be banded with a bar of the same depth and thickness as the main bearing bars of the grating or furnished with continuous cross bridges. Each cut bar shall be welded to the band if banding is utilized. The ends of all grating sections shall be likewise banded.
 - 3. Clamps and bolts used for attaching grating to support members shall be stainless steel. All grating shall be clamped unless noted otherwise. Clamps shall be as recommended by the grating manufacturer.

2.3 MANHOLE FRAMES AND COVERS AND GRATES AND FRAMES

- A. Castings for manhole frames and covers and grates and frames shall conform to ASTM A48 for Class 30 gray iron castings. Castings shall be made accurately to the dimensions as shown on the Drawings. Castings for manhole frames and covers and frames and grates shall be fully interchangeable, sound, smooth, clean, and free from blisters or other defects. Defective castings which have been plugged or otherwise treated shall not be used. Castings shall be thoroughly cleaned and painted or coated with bituminous paint. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.
- B. Manhole frames and covers and grates and frames shall be fitted before leaving the foundry.
- C. Manhole Frames and Covers
 - 1. Manhole frames and covers shall be as shown on the Drawings and shall be as manufactured by East Jordan Iron Works, Neenah Foundry, or approved equal.
 - 2. Manhole covers on sanitary sewer systems shall be solid type unless indicated otherwise on the Drawings.
 - 3. Manhole covers on storm drainage systems shall be vented, unless indicated otherwise on the Drawings.

4. Watertight manhole frames and covers, where indicated on the Drawings, shall be bolt down type and shall be equipped with four 5/8-inch stainless steel bolts and O-ring gasket.
 5. Manhole covers installed on air release and vacuum valve vaults shall be vented.
- D. Grates and Frames: Grates and frames shall be as shown on the Drawings and shall be as manufactured by East Jordan Iron Works, Neenah Foundry or approved equal.

2.4 STEEL ITEMS

- A. Manhole Steps
1. Manhole steps shall be made of a steel rod encapsulated in copolymer polypropylene and shall be model PS-1 PF as manufactured by M. A. Industries, Inc. or approved equal.
 2. Manhole steps shall be installed at intervals as shown on the Drawings. Steps shall be as shown on the Drawings and shall have rod and pull ratings meeting OSHA standards.
- B. Miscellaneous steel shall be fabricated and installed in accordance with the Drawings and shall include: beams, angles, support brackets, splice plates, anchor bolts, lintels and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- C. Stainless Steel. Unless otherwise designated or approved, use stainless steel alloy types as follows which conform to ASTM A167 and ASTM A276.
1. Stainless steel plates and bars shall be Type 316 or Type 317 unless otherwise noted.
 2. Stainless steel anchor bolts shall be Type 316.
 3. Stainless steel bolts, nuts and washers shall be Type 316.

PART 3 - EXECUTION

3.1 FABRICATION

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability.
- B. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Steel accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by fitting.

- C. Welded joints shall be rigid and continuously welded or spot welded as specified or shown. The face of welds shall be dressed flush and smooth. Exposed joints shall be close fitting and jointed where least conspicuous.
- D. Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown, specified, or permitted by the Engineer. All welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.
- E. Welding of aluminum work shall be on the unexposed side as much as possible in order to prevent pitting or discoloration.
- F. All aluminum finish exposed surfaces, except as specified below, shall have manufacturer's standard mill finish. A coating of methacrylate lacquer shall be applied to all aluminum before shipment from the factory.
- G. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the Engineer. All finished surfaces shown on the Drawings and/or specified shall be machined to a true plane surface and shall be true and seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified or shown shall not be reduced in obtaining finished surface. Castings will not be acceptable if the actual weight is less than 95 percent of the theoretical weight computed from the dimensions shown. The Contractor shall provide facilities for weighing castings in the presence of the Engineer showing true weights certified by the supplier.
- H. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust, and foreign matter before shipment and shall be given one shop coat of primer compatible with finish coats specified in Painting Section after fabrication but before shipping. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces, Abrasions in the field shall be touched up with primer immediately after erection.
- I. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Following all manufacturing operations, all items to be galvanized shall be thoroughly cleaned, pickled, fluxed, and completely immersed in a bath of molten zinc. The resulting coating shall be adherent and shall be the normal coating to be obtained by immersing the items in a bath of molten zinc and allowing them to remain in the batch until their temperature becomes the same as the bath. Coating shall be not less than

2 oz. per sq. ft. of surface. The galvanized coating shall be chromate treated.

3.2 INSTALLATION

- A. Install all items furnished except items to be imbedded in concrete which shall be installed under Division 3. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown and in accordance with manufacturer's instructions and approved shop drawings. All dimensions shall be verified at the site before fabrication is started.
- B. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

END OF SECTION

SECTION 05524

COMPONENT ALUMINUM HANDRAIL

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this Section includes furnishing all labor, equipment, and materials required to furnish and install component aluminum handrail including all fittings, anchors, sleeves, and accessories, as shown on the Drawings and specified herein.
- B. Unless specifically designated on the Drawings, all handrails shall be component aluminum handrails meeting the requirements of this section of the Specifications.
- C. Handrails shall be furnished and installed where shown on the Drawings.
- D. Handrails shall be furnished with a toe board, except on the railings for stairs or where concrete curbs are provided.

1.2 DESIGN REQUIREMENTS

- A. Component aluminum handrail system, including railings, posts, and gates, shall be designed and constructed in strict compliance with the requirements of OSHA and the International Building Code (IBC 2018).
- B. Component aluminum handrail system shall also be designed:
 - 1. To withstand the working loads below with a minimum factor of safety of 1.5 based on the ultimate strength of the alloy used.
 - 2. For a minimum safe working load of both of the following loads:
 - a. 50 pounds per linear foot applied horizontally to the top rail and a vertical load of 100 pounds per foot applied simultaneously.
 - b. A 200-pound concentrated load applied in any direction at any point of the railing.
- C. Splice joints shall be designed and constructed to provide strength equivalent to a straight section of pipe.

1.3 SUBMITTALS

- A. Submit complete shop drawings and product data in accordance with the requirements of the General Conditions.
- B. Submit, in accordance with the requirements of the General Conditions,

manufacturer's recommendations and procedures for maintaining and repairing handrail, including methods, cleaning materials, refinishing materials, and precautions as to the use of materials which may be detrimental to handrail finish.

- C. Submit certifications as required in Paragraph QUALITY ASSURANCE below.

1.4 STORAGE AND PROTECTION

- A. Keep handling to a minimum and maintain protective covering on handrail until the work is complete. The Contractor shall take care in handling the rails during shipment, unloading, erection, and during construction to prevent damage to the railing.
- B. Railing and post components shall be individually wrapped in paper or plastic film sleeves to protect the finish during shipment and installation and shall not be covered with any protective paper or other covering which can adhere to, or damage, the components.

1.5 QUALITY ASSURANCE

- A. The Contractor shall provide the Engineer with written certification that the aluminum handrail and accessories are designed and manufactured in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the aluminum handrail supplier may be considered evidence of compliance, provided such tests are performed in accordance with the appropriate ASTM Testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on certified sample of handrail stock. Cost of this testing shall be borne by the Contractor.
- B. Furnish a manufacturer's inspection certificate stating that the handrail system as installed meets the requirements of these Specifications and the Manufacturer's written instructions. Contractor shall correct all inadequacies found during the inspection process.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Component aluminum handrail system shall be manufactured by Thompson Fabricating Company of Birmingham, Alabama, Alumagard of Denver, Colorado, or Hollaender Manufacturing of Cincinnati, Ohio.

2.2 MATERIALS AND CONSTRUCTION

- A. Railing: Railing shall be an extruded tube manufactured from an aluminum alloy

in accordance with ASTM B221, Alloy 6105, Temper T5. Railing shall have a minimum outside diameter of 1.90 inches. Railings shall have a minimum wall thickness of 0.145 inch.

B. Posts:

1. Posts shall be an extruded tube manufactured from an aluminum alloy in accordance with ASTM B221, Alloy 6105, Temper T5. Posts shall have a minimum outside diameter of 1.90 inches. Posts shall have a minimum wall thickness of 0.20 inch.
2. The posts shall have an internal reinforcing dowel to assist in the transfer of the loadings from the post to the base. The dowel length shall extend 12 inches (or longer if required by the manufacturer to meet criteria) above the walking surface and recessed 1/4 inch from bottom of post and shall be tack welded in two locations to secure dowel in the post.

C. Expansion Anchor Bolts: Expansion anchor bolts shall be designed with a safety factor of 4 on ultimate withdrawal and shear in 4,000 psi concrete. Expansion bolts shall be spaced a minimum of 10d apart with 5d minimum edge distance without reduction of withdrawal and shear values used in calculations. Expansion bolts shall be stainless steel of wedge type construction, as specified in Section 05500, MISCELLANEOUS METAL, of these Specifications.

D. Fasteners: Handrail system shall be assembled using components that make rigid joints. Railing joints shall be assembled using stainless steel set screws. Other joints shall be assembled using stainless steel fasteners. No pop riveted, glued systems, or welded railing will be allowed.

E. Anodizing: All railing and posts, and their components, shall be anodized in accordance with Aluminum Association Standard AA-M10-C22-A41 on all exposed surfaces.

F. Brackets and Bases:

1. Side mount brackets shall be nonwelded extrusions attached to posts with stainless steel set screws.
2. Top mounted bases shall be al-mag castings, anodized. Castings shall be permanent mold or die cast. If bases are sand castings or machined, they shall be finished smooth prior to anodizing to approximate the finish of permanent molds or die cast satisfactory to the Engineer. Castings shall be attached to the post with stainless steel set screws and pressure plate. Cast bases shall slip over the outside of the pipe post so that the pipe and integral internal dowel may function together in transferring the load to the base flange. Aluminum bases of welded construction are not acceptable.

G. Handrail system shall provide for draining of entrapped water from the railing systems by minimum 15/64-inch diameter weep holes or other approved means.

- H. Toeboards: Toeboards shall be of the same material and finish as the rails and posts. Toeboards shall be extruded design that clamp to the post to allow expansion and contraction. Toeboards shall have a minimum height of 4 inches.
- I. Gates: Gates shall be of the same material and finish as the rails and posts. Gates shall be equipped with a spring to assist in closing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Handrail system shall be assembled and installed in strict compliance with the manufacturer's instructions. Maximum post spacing shall be 6 feet 0 inch. The handrail manufacturer may use less than 6 feet 0 inch if their system requires closer spacing to meet design criteria.
- B. Shop Assembly: Handrail manufacturer shall shop assemble the handrail in shippable modules not to exceed 30 feet in length. Field manufacturing of handrail modules will not be permitted.
- C. Set handrail modules plumb within 1/8 inch of vertical and align horizontally to within 1/8 inch in 12 feet. Set stair rail modules plumb within 1/8 inch of vertical and set rake rails aligned horizontally to 1/8 inch in 12 feet.
- D. Handrail mounting shall be embedded, top mounting base, or side mounted. Install expansion bolts to proper depth to develop full withdrawal and shear values. Check all fasteners and bolts in base connections and splices for tightness.
- E. Handrail components coming into contact with concrete or dissimilar metals shall be coated with bituminous protective coating or installed with a vinyl isolation gasket.
- F. Splice joints to facilitate removal of pipe railing shall be provided at all intersections, changes in direction, or at intervals not to exceed 30 feet in straight runs of railing.
- G. Adequate provisions for expansion and contraction shall be incorporated in the rails. Expansion joints shall be placed at 60-foot intervals. Handrail shall not be continuous across the concrete expansions joints.
- H. Open rail ends shall be closed by terminal end fittings.
- I. Gates shall be provided in all handrail openings. Chains will not be permitted at handrail openings.
- J. Toeboards shall be shipped loose and field assembled to posts with clamps. The attaching system shall be such that contraction and expansion can occur while maintaining a straight line. Toeboards shall be set so that the bottom of the toeboard is within 1/4 inch above the walking surface.

- K. All defective, damaged, or otherwise improperly installed handrail shall be removed and replaced with material that satisfies the requirements of this Section.

3.2 CLEANING

Following installation, aluminum handrail shall be cleaned using soap and clean water. Acid solutions, steel wool, or harsh abrasives shall not be used. If stains remain after cleaning, remove finish and restore in accordance with the manufacturer's written instructions to the satisfaction of the Engineer.

END OF SECTION

SECTION 07900

CAULKING AND SEALANTS

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall furnish all materials, labor, equipment, and incidentals required to perform all caulking, and related work necessary for the proper completion of the project as required by the Drawings and as specified herein.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

1.2 APPLICATION SCHEDULE

- A. Caulk all exterior wall joints between frames in openings and adjacent materials, between masonry and cast in place concrete, expansion and control joints and all other joints shown on the Drawings or required for the completion of the work.
- B. Caulk all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete and control joints, exterior window and door frames and all other joints shown on the drawings or required for the completion of the work.
- C. Joints of similar nature to those indicated shall be sealed with same sealer, whether indicated on Drawings to be sealed or not.

1.3 SUBMITTALS

- A. Submit to the Engineer as provided in the General Conditions for shop drawings, detailed information on materials proposed and installation methods.
- B. Product Data: Manufacturer's technical data for each joint sealer product required, including instructions for joint preparation and joint sealer application.

- C. Samples for Color Selection: Manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available, for each product exposed to view.
- D. Samples for Color Verification: Samples of each type and color of joint sealer required. Install joint sealer samples in 1/2 inch wide joints formed between two 6 inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealers in the Work.

1.4 QUALITY ASSURANCE

- A. Applicable standards: Standards of the following, as referenced herein:

ASTM C 920-98 Standard Specification for Elastomeric Joint Sealants, 1998.
- B. Preinstallation Meeting: The contractor shall arrange a meeting with installer, sealer manufacturers' representatives, and other trades whose work affects installation of sealers at project site to review procedures and time schedule proposed for installation of sealers which is coordinated with other related work.

1.5 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels showing manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of sealers under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by sealer manufacturer or below 40 degrees F (4.4 degrees C).
 - 2. When substrates are wet due to rain, frost, condensation, or other causes.

- B. Joint Dimension Conditions: Do not proceed with installation of sealers when joint dimensions are less than recommended by joint sealer manufacturer for application indicated.

PART 2 - PRODUCTS

2.1 CAULKING

- A. Caulking Compound: One component, synthetic rubber base sealant, soft curing, nonstaining, conforming to F.S. TT S 00230 and Thiokol's Building Trade Performance Specifications for Type 1 Class B sealants. Caulking for use within chemical containment areas shall be one component, elastomeric, ultra chemical resistant sealant. Colors shall be selected by the Engineer.
- B. Primer: As recommended by caulking compound manufacturer.
- C. Back up Material: Closed cell foam polyethylene, or similar non bituminous material as recommended by manufacturer of caulking compound and completely compatible with selected compound.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION AND INSTALLATION

- A. Remove dirt, grease, mortar droppings and other foreign matter from substrate.
- B. Require installer to inspect joints indicated to receive joint sealers for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not allow joint sealer work to proceed until unsatisfactory conditions have been corrected.

3.2 CAULKING

- A. Surface Preparation: Clean metal surfaces free of grease, oil, wax lacquer, and other foreign residue by wiping with a clean cloth moistened with a suitable solvent. Scape or brush masonry surfaces clean. Apply appropriate primer to contact surfaces.
- B. Joint Preparation: Joints to be caulked having a depth in excess of 3/8 inch shall be packed with back up material. Round back up material shall be sized to require 20 percent to 50 percent compression upon insertion. In joints not of sufficient depth to allow packing, install polyethylene bond breaking tape at back of joint. Avoid lengthwise stretching of back up material. Cut all corners, avoid wrapping around corners.

- C. Application: Apply compound with pressure flow gun with nozzle of proper size and shape to suit width of joint, promptly after mixing and with sufficient pressure to fill joint. Apply as a continuous operation horizontally in one direction, and vertically from bottom to top, except joints having excessive widths where compound might sag, the joints shall be built up with successive beads. Finish joints smooth and slightly coved.

3.3 PROTECTION AND CLEANING

- A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.
- B. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints

+++ END OF SECTION +++

SECTION 08 16 13

FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and deliver fiberglass reinforced plastic (FRP) doors, frames and glazed transoms with appurtenances as shown, as scheduled, and as herein specified.
- B. Installation is included in this Section and as specified and shown on shop drawings as submitted herein.

1.2 RELATED WORK

- A. Section 06 10 53, Rough Carpentry.
- B. Section 08 71 00, Door Hardware.
- C. Section 08 81 00, Glass Glazing.

1.3 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Section 01 33 00, Submittal Procedures, shop drawings of all fiberglass reinforced doors, frames and appurtenances. Shop drawings shall show each door and frame type, schedule of doors and frames, door and frame elevations and details, conditions at openings with various wall thicknesses and materials, location and installation requirements for hardware, thickness of materials, joints, connections and trim, and frame anchorage meeting Code requirements.
 - 1. The CONTRACTOR shall provide to local authorities, if required, manufacturer's anchorage details meeting project design loads and specific Code requirements for this jurisdiction, for door frames submitted.
- B. Hardware templates shall be furnished to the door manufacturer by the CONTRACTOR for correct hardware alignment and reinforcing.
- C. Submit to the hardware supplier the requirements of any hardware for exterior doors that is necessary to be a component of the door system in order to conform to the applicable Building Code.

- D. Submit to the glazing supplier the requirements of any glazing for exterior doors that is necessary to be a component of the door system in order to conform to the applicable Building Code.
- E. When requested by ENGINEER, submit two each of the following samples of fire rated and non-rated doors and frames for review. Samples shall be full size and show gauges, configuration, construction, and finish proposed for the various components. Resubmit new samples of each as required until approval is obtained.
 - 1. Corner Sample: Construction of doors, 6" x 6".
 - 2. Corner Sample: Construction of frame, 6' section in proposed finish.
 - 3. Corner Sample: Louver.
 - 4. Corner Sample: Window Kit and Glazing bead.
- F. Provide copy of current, valid statewide product approval for product, material or system specified in this section and on the drawings, in accordance with Rule 9B-72. Product Approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number indicated on the "Approved Product Listing Table" on the drawings. If a substitution product (not listed on the Approved Product Table) is submitted by the CONTRACTOR, the CONTRACTOR shall be responsible to file the appropriate Product Approval information with the authority having jurisdiction.
- G. Provide manufacturer's recommended maintenance procedures.

1.4 QUALITY ASSURANCE

- A. Provide FRP components manufactured by a single firm specializing in this type of work, unless otherwise acceptable to the ENGINEER.

1.5 REGULATORY REQUIREMENTS

- A. The products, materials, and assemblies, including anchorage, proposed for the work of this Section shall comply with the project specific calculated design pressures, the applicable Building Code (Code), including high-velocity hurricane requirements, and shall be designed by the Manufacturer and installed by the CONTRACTOR to meet these requirements. Refer to project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Code, the more stringent requirement shall apply.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All doors and frames shall be shipped with trim and all necessary items which may be required for final installation.

- B. All materials shall be delivered to the site in sealed, undamaged containers, fully identified with manufacturer's name, brand, style, pattern, and color. Upon delivery to the job site, materials shall be stored in original cartons, on end in such a way to prevent falling or damage to face, corners, or edges.

1.7 WARRANTY

- A. Provide written ten (10) year warranty. Materials and workmanship to be free from defects from date of shipment. Provide lifetime warranty from degradation or failure due to corrosion from date of shipment, provided that the structural integrity of the doors and frames have not been violated or compromised. (No unauthorized cuts, bores or other structural alterations affecting the core of the door or the structure of the frame.)

PART 2- PRODUCTS

2.1 GENERAL

- A. All exterior doors and components shall be designed by the Manufacturer and installed by the CONTRACTOR to withstand wind pressures, both positive and negative and salient corner conditions as calculated in accordance with the Building Code to withstand the wind load required by the Building Code. Minimum requirement will be ± 70 psf.
- B. At no additional cost to the OWNER, provide additional, non-standard door bracing, reinforcements or heavier gauge materials required in order to conform to wind load requirements herein.

2.2 MANUFACTURER

- A. FRP components shall be by CORRIM Company.
 - 1. Exterior Doors shall be model HC-FRP (FBC App/Seq # FL5705).
 - 2. Interior Doors shall be model FRP-1.
 - 3. Interior Doors at Fire Rated openings shall be model Polyfire.
- B. FRP components shall be by Chem Pruf.
- C. FRP components shall be by Tiger Door.
- D. Or Approved Equal.

2.3 DOORS

- A. External Construction – Doors to Seamless Construction.
 - 1. Face Sheets: Standard Face Sheets shall be manufactured using corrosion resistant resin system with light stabilizing additives. The resin shall be reinforced with fiberglass, 40% by weight.

2. Face Sheets shall be .070" to .125" in thickness. Standard being .120". Total door thickness to be a nominal 1-3/4".
3. Finish of face sheets:
 - a. 15 mils thick coverage $\pm$.3 mils.
 - b. Color: Provide full selection of standard and custom colors to be selected by ENGINEER from manufacturer's color charts.

B. Internal Construction

1. Core:
 - a. Exterior Doors – Polyurethane foam core, of end grain construction, shall be laminated to the interior of the panels. The Balsa shall have a density of 8.5-9.0 lbs./cu. ft. and shall be 1-1/2" thick. Compressive strength, perpendicular to the door panel surface shall be 1400 psi.
 - i. Thermal Resistance: R-Value of R-12.
 - b. Interior Doors – Honeycomb, Phenolic impregnated resin honeycomb.
 - c. Fire Rated Doors – Mineral core, fire-rated as per schedule (U.L. Label)

C. Hardware Preparations

1. Reinforcement Blocking for all applied hardware: Non-swelling polymer blocking.
2. Mortise Hardware Reinforcement and Preparation: All doors shall be mortised and reinforced to allow application of hinges and locks, in accordance with the hardware schedule and manufacturer's templates. The hinges shall be attached using stainless-steel wood screws.
3. Pilot holes shall be in strict accordance with manufacturer's recommendations.

D. Door Accessories

1. Glazing: Glass support structures shall ensure that the glass area is weather sealed as not to permit moisture to enter the core of the door. This is to be accomplished by utilizing pultruded FRP tubes to fabricate the window opening. Glazing must allow for ready access for repair, in event of damage or replacement, without affecting the sealed integrity of the cutout in the door panel itself. Openings cut into the core material will not be allowed.
2. Exterior doors shall have factory installed glazing, using materials, including frame and attachment, to comply with the design loads indicated on the structural drawings, and the Building Code requirements.
3. Louver: Louvers, when indicated on drawings, shall be fabricated of FRP material of an inverted "V" design, and shall be subject to the same performance requirements as the door panel. The louver opening shall be fabricated in the same method as for glazing above.
4. Fasteners: Provide stainless steel fasteners as required for glazed openings and louvers.
5. Transoms: All transom panels will be identical to the doors in construction, materials, thickness, color, and reinforcement, and when indicated on drawings, shall be removable without the need of special tools.
6. Astragals: Astragals for pairs of doors to be fabricated of FRP material of manufacturer's standard flat design.

2.4 FRAMES

- A. Frame Fabrication FRP.
 - 1. Jamb Depth: Frames shall be fabricated with jamb depth to wrap wall as shown on plans and schedules.
 - 2. Face dimension: All frames will be constructed with 2" faces.
 - 3. Stops: All stops will be 5/8".
 - 4. Corner Miter: Head and Jamb members shall be standard 45-degree miter, providing a neatly mitered corner connection, fabricated for Knocked Down (KD) field assembly.
- B. Reinforcements and Brace/Supports
 - 1. Corner Reinforcement: 4" X 4" X 5-3/8" X *W'* thick pultruded fiberglass angle, attached to head bar at factory using stainless steel screws or suitable polymer rivets.
 - 2. Mortise Hinge Reinforcement: 1-1/2" x 7" x *W'* thick polymer, attached to frame at factory by means of bonding and stainless-steel countersunk screws.
 - 3. Closer Reinforcement: 1-1/2" x 12" x *W'* thick polymer, attached to frame at factory by means of bonding.
 - 4. Strike Reinforcement: 1-1/2" x 9" x *W'* thick polymer material, attached to frame by means of bonding and stainless-steel countersunk screws or suitable polymer rivets.
- C. Anchoring Systems
 - 1. Concealed existing wall anchors.
- D. Finish
 - 1. Gelcoat
 - a. 15 mils thick coverage ± 3 mils
 - b. Standard Color to be selected by ENGINEER from manufacturer's color chart.

2.5 FABRICATION

- A. Fabricate FRP doors and frames as shown on plans and schedules and in accordance with best shop practices. Frames shall be rigid, neat in appearance and free from defects. Field measurements shall be taken as required for coordination with adjoining work.
- B. Form exposed surfaces free from warp, wave, and buckle, with all corners square, unless otherwise shown. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.
- C. Reinforce members and joints with plates, tubes or angles for rigidity and strength.

- D. Doors and Frames shall be mortised and reinforced for hardware in accordance with the hardware manufacturer's instructions and templates. The reinforcing shall be designed to receive hinges, locks, strikes, closers, etc.
- E. Furnish a minimum of three (3) metal anchors or polymer spacers per jamb of frames up to 84" in height. Add one (1) additional anchor for each 24" in height above 84". Anchors shall be shaped, sized and spaced as shown or required for anchorage into adjoining wall conditions. Fabricate joint anchor of stainless steel.
- F. Terminate bottom of frames at the indicated finished floor level.
- G. Provide clearance for doors of 1/8" at jambs and heads; 1/8" clearance above threshold.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer shall examine the substrate and conditions under which fiberglass reinforced plastic work is to be installed and notify the CONTRACTOR in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer or ENGINEER.

3.2 INSTALLATION

- A. General: Install FRP doors, frames, and accessories in accordance with the final shop drawings, NFPA 80 standards at fire rated openings, and as herein specified. Installation to be similar to that of hollow metal doors and frames, and in accordance with FRP manufacturer's written instructions.
- B. Frame Installation:
 - 1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged. Frames must NOT be drilled for brace supports as finish and moisture seal may be damaged.
 - 2. In masonry construction, locate wall anchors in jamb, placing one at each hinge and strike levels. Frames grouted full of mortar at jambs and anchors shall be built into the joints as walls are laid up. A continuous bead of silicone sealant is to be applied between head and jamb at the miter joint.
- C. Door Installation:
 - 1. Fit FRP doors accurately in frames, within clearances specified in Paragraph 2.5., G. of this section.

3.3 TOLERANCES

- A. Maximum diagonal distortion allowed is 1/4", measured with a straight edge, corner to corner. Maximum measurable plane is 4'-0" x 7'-0".

3.4 ADJUSTING

- A. At substantial completion, adjust all operable components to ensure proper installation and that all openings function smoothly and freely.

3.5 CLEANING

- A. Remove dirt and excess sealant from exposed surfaces. Follow the manufacturer's recommended cleaning techniques and procedures for cleaning all surfaces. Use only cleaning products that will not scratch or damage the surfaces and are recommended by the manufacturer.
- B. Remove debris from project site.

+ + END OF SECTION + +

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all aluminum windows Work.
2. Extent of the aluminum windows is shown and specified.
3. Types of products required include the following:
 - a. High Performance Insulated Thermal-Barrier Aluminum Windows:
 - 1) Fixed thermal barrier aluminum windows.
 - 2) Miscellaneous materials.
 - 3) Anchors, inserts, support brackets, expansion devices, fasteners, flashings, weeps, and similar elements in conjunction with each of the above components.
 - b. Polyvinylidene fluoride finishes and colors with extended life topcoat.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the aluminum windows Work.

C. Related Sections:

1. Section 07 92 00, Joint Sealants.
2. Section 08 81 00, Glass Glazing.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. AAMA 101, Voluntary Specifications for Aluminum Prime Windows and Sliding Glass Doors.
2. AAMA 302.8, Specification for Aluminum Windows.
3. AAMA 701-702, Voluntary Specification for Pile Weatherstrip and Replaceable Fenestration Weatherseals.
4. AAMA GS-001, Guide Specifications for Aluminum Architectural Windows.
5. ASTM B 117, Practice for Operating Salt Spray (Fog) Apparatus.
6. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
7. ASTM D 522, Test Methods for Mandrel Bend Test of Attached Organic Coatings.
8. ASTM D 523, Test Method for Specular Gloss.

9. ASTM D 968, Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
10. ASTM D 1308, Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
11. ASTM D 2244, Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
12. ASTM D 2247, Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
13. ASTM D 4214, Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
14. ASTM E 283, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
15. ASTM E 330, Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
16. ASTM E 331, Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.
17. FS RR-W-365, Wire Fabric.
18. NAAMM Metal Finishes Manual for Architectural and Metal Products.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Installer's Qualifications:

1. Installer shall be certified by the manufacturer of the aluminum windows to install the product accepted for this Project. Installer shall provide evidence of at least five years installing similar product to the product accepted for this Project as well as at least three references for projects where the exact product accepted for this Project has been successfully installed.
2. Submit name and qualifications of the installer to the ENGINEER.

C. Finish Applicator Qualifications:

1. Provide aluminum window finish applicator experienced in the handling and application of the finish coatings specified, acceptable to the coating or aluminum manufacturer.
2. Engage a firm with documented successful experience in the manufacturer of aluminum window Work of similar scope and type to the required Work.

- D. Component Supply and Compatibility:
1. Obtain all products included in this Section regardless of the component manufacturer from a single aluminum window manufacturer.
 2. The aluminum window manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the aluminum window manufacturer.
- E. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
- G. Codes: Comply with the applicable requirements of codes referenced in Section 01 42 00, References.
- H. Mock-Ups:
1. Prior to the installation of aluminum window system with Project operable vent and accessories, but after ENGINEER'S approval of Samples and Shop Drawings, install sample of aluminum window system with Project operable vent, in an area selected by ENGINEER to show a representative installation of the Work. Obtain ENGINEER'S acceptance of visual qualities of the mock-up before start of the Work. Retain and protect mock-up during construction as a standard for judging completed aluminum window system with Project operable vent Work. Do not alter mock-ups, unless given written permission by ENGINEER.
 2. Work that does not meet the standard approved on the sample areas shall be removed and replaced with new material, as required by ENGINEER.
- I. Pre-Installation Conference:
1. Prior to the installation of the aluminum windows and associated Work, CONTRACTOR shall schedule and meet at the Site with the aluminum window installer, the installer of each component of associated work, the installers of substrate construction to receive the Work, the installers of other Work in and around aluminum windows that follows the aluminum window Work, including mechanical Work, ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the aluminum window Work, including but not necessarily limited to, the following:
 - a. Review Project requirements, including Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review status of mock-up.
 - d. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

- e. Review required inspection, testing, certifying and accounting procedures.
 - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - g. Review regulations concerning code compliance, field testing requirements and similar considerations.
 - h. Review procedures needed for protection of aluminum window system during the remainder of the construction period.
2. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.
 3. Record any revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Fabrication and installation of aluminum window units and associated components of the Work. Include wall elevations at 1/4-inch scale, typical unit elevations at 1-inch scale and full-size detail sections of every typical composite member. Show anchors, hardware, operators and other components not included in manufacturer's standard data, including glazing details. Indicate clearly on the Shop Drawings, all deviations from Contract Documents.
2. Product Data:
 - a. Copies of manufacturer's specifications, recommendations and standard details for aluminum window units, including fabrication, finishing, hardware and other components of the Work. Include certified test laboratory reports as necessary to show compliance with the requirements.
 - b. Copies of manufacturers' specifications and installation instructions for required materials and components, which are not included in the other submittals, specified in other Sections of these Specifications. Coordinate the submittal of such other data with this submittal, and with the submittal of samples required by other Sections.
3. Samples:
 - a. Samples of each required aluminum color and finish, on 12-inch long sections of extrusion shapes as required for the aluminum window units.
 - b. Samples will be reviewed by ENGINEER for color and texture only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. High Impact Certification.
2. Test and Evaluation Reports: Certified laboratory test reports for required performance tests.

3. Field Quality-Control Reports.
 4. Qualification Statements:
 - a. Manufacturer.
 - b. Installer
 - c. Finish applicator.
- C. Closeout Submittals: Submit the following:
1. Operations and Maintenance Documentation: Upon completion of the Work, furnish copies of detailed maintenance manual including the following information:
 - a. Product name and number.
 - b. Name, address, e-mail address and telephone number of manufacturer and local distributor.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches, and staining.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum window systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:

- a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
- 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
- 1. Except as otherwise shown or specified, the requirements for aluminum windows, and the terminology and standards of performance and fabrication workmanship, are those specified and recommended in AAMA/WDMA/CSA 101/I.S.2/A440, and the applicable general recommendations published by Architectural Aluminum Manufacturer's Association, National Association of Architectural Metal Manufacturers and Aluminum Association.
 - 2. All standard features and finishes offered by the named manufacturers shall be made available to ENGINEER from any "or equal" manufacturer submitted by CONTRACTOR.
 - 3. High Performance Insulated Thermal-Barrier Aluminum Windows:
 - a. Performance and Testing: Except as otherwise specified, comply with the air infiltration tests, water resistance tests and applicable load tests specified in AAMA 101 for the type and classification of aluminum window units required in each case.
 - b. Comply with minimum Architectural Performance Class and Section 4 "Optional Performance Grades" of AAMA 101 Group II-Compression Seal Window Products AP-AW65, Architectural and AW-PG80-FW, Fixed.
 - c. Design Pressure-Inswing:
 - 1) Provide uniform structural test pressure of 125 pounds per square

- foot.
- 2) Air Infiltration Test, ASTM E 283: Maximum infiltration 0.1 cubic feet per minute per linear foot of operating ventilator when tested at 6.24 pounds per square foot differential pressure. Verify with local codes.
 - 3) Water Penetration Test, ASTM E 331: No water penetration for 15 minutes when window is subjected to rate of flow of five gallons per hour per square foot with differential pressure across window unit of ten pounds per square foot.
 - 4) Wind Load Test, ASTM E 330: Minimum 50 pounds per square foot positive and negative load for ten seconds. Maximum deformation of frame or sash member $L/175$ of span length.
 - 5) Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x hx deg F.
 - 6) Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.
 - 7) Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
 - 8) Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.
- d. Testing: Wherever manufacturer's standard window units comply with the requirements and have been tested in accordance with the specified tests, provide certification by the manufacturer of compliance with such tests; otherwise, perform the required tests through a recognized testing laboratory or agency and provide certified test results.
 - e. Provide aluminum window system to withstand thermal expansion and contraction movements resulting from not less than an ambient temperature range of 120°F, which may cause an aluminum window system temperature range of 140°F. Limit the deflection as for wind pressure loading. Thermal movements shall not cause permanent deformation, cracking, opening of joints, undue stress on fasteners, or other effects detrimental to weathering performance.
 - f. The design of the aluminum window system as shown and specified is intended to prevent excessive condensation on the indoor faces of the Work, with the heating and ventilating system in operation, and under the following conditions. Provide aluminum window systems that achieve and maintain this design intention:
 - 1) Outdoor: Ambient temperature 120°F, 140 miles per hour wind.
 - 2) Indoor: Ambient temperature of 70°F, relative humidity of 50 percent.
 - 3) Excessive condensation is defined as visible water or frost.
 - g. Provide internal drainage to lead all infiltrated water to the exterior through weep slots.

- h. Other Loading: Applicable requirements of the International Building Code with Georgia Amendments, latest edition.

2.2 MANUFACTURERS

- A. Hurricane Impact Resistant Window (2" - 2-1/4" Deep) Manufacturers: Provide products of one of the following:
 - 1. IPT200 Fixed Windows by Arcadia Incorporated.
 - 2. Series 2701 Impact Thermal Fixed Window by EFFCO Corporation, a Pella Company.
 - 3. YOW 225 TUH Fixed Windows by YKK AP America Inc is a subsidiary of *YKK Corporation of America*.
 - 4. Aluminum Series IW8100 Fixed Windows by C.R. Laurence Co., Incorporated, CRH Company.
 - 5. 8225TL Series Fixed Windows by Kawneer Company, Inc.
 - 6. Or equal.

2.3 MATERIALS

- A. Aluminum Extrusions: Alloy and temper, AAMA/WDMA/CSA 101/I.S.2/A440 and not less than 1/8-inch thickness at any location for mainframe sash members and tube supports. Vertical mullions and support clips as recommended by the window manufacturer.
- B. Thermal Separator: Interior and exterior aluminum frame sections shall be thermally separated by a continuous polyurethane connector.
- C. Fasteners: Stainless steel, guaranteed by the manufacturer to be non-corrosive and compatible with the aluminum window members, trim, hardware, anchors and other components of the window units.
 - 1. Do not use exposed fasteners, except where unavoidable for the application of hardware. Match the finish of the metal surrounding the fastener, unless otherwise specified.
 - 2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise specified.
- D. Glass and Glazing Materials: Refer to Section 08 81 00, Glass Glazing.

2.4 WINDOW CLASSIFICATION (GRADE)

- A. AP-AW5070, Architectural Windows: Provide window units complying with the following:
 - 1. Extruded aluminum-glazing stops of 0.060inch minimum wall thickness, except 0.050inch minimum for snap-on type.
 - 2. Hardware and anchors of non-magnetic stainless steel and white bronze.
 - 3. Fabricate units with all main corners and intersections of frame and sash mitered. Provide double tubular frame with hydraulically crimped gusset

corner construction. Mortise or cope secondary members to fit, and weld in place with hairline joints.

4. Provide metal thickness as required to withstand performance requirements, but not less than 0.125-inch for frame members.
5. Provide means of drainage for water and condensation, which may accumulate in members of the window units.

2.5 FABRICATION AND ACCESSORIES

- A. General: Provide specified manufacturer's standard fabrication and accessories, except to the extent more specific or more stringent requirements are specified. Include complete system for assembly of components and anchorage of window units, and prepare sash for glazing.
- B. Sizes and Profiles: The required sizes for window units and the profile requirements are shown. The details shown are based upon standard details by one or more manufacturers. It is intended that similar details by other manufacturers will be acceptable, provided they comply with the size requirements, and with minimum/ maximum profile requirements specified.
- C. Coordination of Fabrication: Wherever possible check actual window openings in the construction Work by accurate field measurement before fabrication, and show recorded measurements before fabrication, and show recorded measurements on final Shop Drawings. However, coordinate fabrication schedule with construction progress as directed by CONTRACTOR to avoid delay of the Work. Where necessary, proceed with fabrication without field measurements, and coordinate installation tolerances to ensure proper fit of window units.
- D. Provide mullions and cover plates as shown, matching window units and complete with anchors for support to structure and for installation of window units. Allow for erection tolerances and provide for movements of window units due to thermal expansion and building deflections.
- E. Provide serrated sash for pre-shimmed glazing tape.
- F. Provide extruded aluminum true-divided mullions, and custom aluminum panning as shown.
- G. Subsills: Thermally broken, extruded aluminum subsills in configurations indicated on Drawings.
- H. Column Covers: Extruded aluminum profiles in sizes and configurations indicated on Drawings.
- I. Interior Trim: Extruded aluminum profiles in sizes and configurations indicated on Drawings.

- J. Panning Trim: Extruded aluminum profiles in sizes and configurations indicated on Drawings.
- K. Receptor System: Two-piece, snap-together, thermally broken, extruded- receptor system that anchors windows in place.

2.6 ALUMINUM WINDOW FINISHES

- A. Three Coat Fluorocarbon Coating:
 - 1. Aluminum windows to be finished with a minimum 1.4 mil thick full strength 70% resin, 3 coat Fluoropolymer system, meeting AAMA 2605 performance requirements.
 - 2. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pretreatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a color coat and a clear PVF2 topcoat. It shall receive a bake cycle of 17 minutes at 4500F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
 - 3. Manufacturer to furnish an extended 20 limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.
 - 4. Provide the following colors:
 - a. Aluminum Window Mullions and Adapters: Match existing.
 - b. Snap Covers and Closures: Match existing .
 - c. Exposed Fasteners: Color and finish to match substrate.
 - 5. Products and Manufacturers: Provide one of the following:
 - a. Duranar XL 3 Coat System by PPG Industries Coatings and Resins Division, Incorporated.
 - b. Fluoropon Premiere by Valspar Corporation.
 - c. Or Equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and conditions under which aluminum window system Work is to be installed and notify ENGINEER, in writing, of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until satisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

- A. Comply with manufacturer's specifications, installation manuals and recommendations for the installation of window units, hardware, operators, and other components of the Work.

- B. Erection Tolerances:
1. Limit variations from plumb, level or dimensioned angle to the following:
 - a. 1/8-inch maximum deviation in story height or in 10-foot vertical or angular run, and in 20-foot horizontal runs.
 - b. 1/4-inch maximum deviation in 40-foot runs, all directions.
 2. Limit variations from theoretical member locations shown, based on established floor lines and column lines, including variations from plumb and level, to the following:
 - a. 3/8-inch total maximum deviation for members at all locations.
 - b. 1/8-inch maximum change in deviation for members for ten-foot runs, all directions.
 3. Limit offsets in end-to-end and edge-to-edge alignments of adjoining and consecutive members, which form planes, continuous runs and profiles, to the following:
 - a. 1/16-inch maximum offset in flush alignment, including members, which are to be 1/2-inch or less out-of-flush, and including members, which are separated 2-inches or less by a reveal or protrusion in the plane of the aluminum window wall.
 - b. 1/8-inch maximum offset in alignments, which are to be out-of-flush by more than 1/2-inch, or separated by a reveal or protrusion of more than 2- inch width.
- C. Anchor units securely in place. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- D. Refer to Section 07 92 00, Joint Sealants, for compounds, fillers and gaskets to be installed concurrently with window units.
- E. Do not install component parts, which are observed to be defective in any way, including warped, bowed, dented, abraded and broken members, and including glass with edge damage.
- F. Do not cut, or trim, component parts during erection, in a manner, which would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the aluminum window wall. Return component parts, which require alteration to the shop for refabrication, if possible, or for replacement by new parts.
- G. Install component parts level, plumb, true to line and with uniform joints and reveals. Secure to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers and fillers. Use erection equipment, which will not mar, or stain finished surfaces, and will not damage the component parts.
- H. Apply a bituminous coating of approximately 30-mil dry film thickness, or other suitable permanent separator, on concealed contact surfaces of dissimilar materials before installation, wherever there is the possibility of corrosive or electrolytic action.

- I. Anchor component parts securely in place as shown, by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movements, which are intended or necessary. Install slip-joint linings to ensure movement as intended or necessary.
- J. Clean debris, dust and other substances from behind the aluminum window wall as it is erected, and provide temporary closures if necessary, to prevent the accumulation of such substances in the void spaces behind the aluminum window walls.
- K. Install thermal barrier between pressure plate and mullion.
- L. Attach pressure plate with screws. Install snap covers over pressure plates.
- M. Install glazing using dry glazing retainers, which provide a firm but resilient clamping grip on the glazing.
- N. Adjust operating sash and hardware to provide a tight fit at contact points and at weatherstripping for smooth operation and weathertight closure.
- O. Refer to Section 08 81 00, Glass Glazing, for installation requirements.
- P. Factory-glaze all windows.
- Q. Clean aluminum surfaces promptly after installation of windows, exercising care to avoid damage of the finish. Remove excess glazing and sealant compounds, dirt and other substances. Lubricate hardware and other moving parts.
- R. Advise CONTRACTOR of protective treatment and other precautions required through the remainder of the construction period, to ensure that window units will be without damage or deterioration, other than normal weathering, at the time of Final Completion.
- S. Maintain the aluminum window wall in a clean condition throughout the construction period, so that it will be without any evidence of deterioration or damage, other than the effects of normal weathering, at the time of Final Completion. Select methods of cleaning which will promote the achievement of uniform appearance and stabilized colors and textures for materials that weather or age with exposure.
- T. CONTRACTOR shall advise ENGINEER, in writing, of protection and surveillance requirements that CONTRACTOR shall provide at no additional cost to the OWNER, to ensure that the aluminum windows Work will be without deterioration or damage at the time of Final Completion by OWNER.

- U. Remove and replace with new material aluminum window components, which have been damaged, including finish, beyond successful repair, as directed by ENGINEER. Repair minor damage.
- V. Immediately before the time of Final Completion, clean the aluminum windows thoroughly, inside and out. Demonstrate proper cleaning methods to OWNER'S maintenance personnel during this final cleaning.
- W. At the completion of the Work, clean or replace adjacent work, marred by the Work of this Section.
- X. Remove all materials and debris and leave the Site of the Work in clean condition.

3.3 FIELD QUALITY CONTROL

- A. Water Penetration Test: Perform test in accordance with NAAMA Standard FC-1: "Field Check for Water Leakage of Metal Curtain Walls", except limit test area to one bay wide (but not less than 20 feet or more than 40 feet) by one story high, located from mid-bay to mid-bay and from mid-story-height to mid-story-height.
- B. Depending upon the prevalence or absence of leakage in the initial water penetration test, and upon measures adopted by the aluminum window wall CONTRACTOR to eliminate sources of leakage from subsequently erected work, the ENGINEER will determine the necessity, and scope of, additional tests. In no case will the total of tested area amount to less than one percent, nor more than ten percent of the aluminum window wall area, except as subsequently authorized by the ENGINEER.

+ + END OF SECTION + +

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install door hardware. Furnish door hardware for all doors in compliance with these Specifications herein.
2. Extent of door hardware is specified. Door hardware is defined to include all items known commercially as door hardware, except special types of unique and non-matching hardware specified in the same Section as the door and door frame.
3. Types of products required include the following:
 - a. Mortise hinges.
 - b. High-security mortise locksets.
 - c. Panic exit devices.
 - d. Heavy-duty, overhead, surface-mounted, door closers.
 - e. Flush bolts.
 - f. Cylinders for doors specified in other Sections.
 - g. Coordinators.
 - h. Astragals.
 - i. Dust-proof strikes.
 - j. Stripping and seals.
 - k. Thresholds.
 - l. Miscellaneous items and accessories for a complete installation functioning in compliance with the requirements of governing authorities having jurisdiction at the Site.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the door hardware.
2. Coordinate the Work of other Sections to provide clearances and accurate positioning of recessed or cast-in-place items.

C. Related Sections:

1. Section 08 16 13, Fiberglass Reinforced Plastic Doors and Frames.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ANSI A117.1, Accessible and Usable Buildings and Facilities.
2. ANSI/BHMA A156.1, Butts and Hinges.

3. ANSI/BHMA A156.3, Exit Devices.
4. ANSI/BHMA A156.4, Door Controls - Closers.
5. ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
6. ANSI/BHMA A156.6, Architectural Door Trim.
7. ANSI/BHMA A156.7, Template Hinge Dimensions.
8. ANSI/BHMA A156.8, Door Controls - Overhead Stops and Holders.
9. ANSI/BHMA A156.13, Mortise Locks and Latches, Series 1000.
10. ANSI/BHMA A156.16, American National Standard for Auxiliary Hardware.
11. ANSI/BHMA A156.18, Hardware - Materials and Finishes.
12. ANSI/BHMA A156.21, Thresholds.
13. ANSI/BHMA A156.22, Door Gasketing and Edge Seal Systems.
14. ANSI/BHMA A156.24, Delayed Egress Locks.
15. ANSI/BHMA A156.25, Electrified Locking Devices.
16. ANSI/BHMA A156.26, Continuous Hinges.
17. ANSI/DHI A115.1, Preparation of Mortise Locks in 1-3/8-inch and 1-3/4-inch Standard Steel Doors and Frames.
18. ANSI/NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
19. ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
20. BMHA, Certified Product Directory.
21. DHI, Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.
22. DHI, Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.
23. DHI, Sequencing and Format for the Hardware Schedule.
24. FF-TT-S-00227,
25. HMMA 830, Hardware Preparation and Locations for Hollow Metal Doors and Frames.
26. NIST, U. S. Standard.
27. NFPA 70, National Electric Code.
28. NFPA 80, Fire Doors and Fire Windows.
29. NFPA 101, Life Safety Code.
30. SDI 109, Hardware for Standard Steel Doors and Frames.
31. SDI 118, Basic Fire Door Requirements.
32. UL 10B, Fire Tests of Door Assemblies.
33. UL 10C, Positive Pressure Fire Tests of Door Assemblies.
34. UL 305, Panic Hardware.
35. UL, Building Materials Directory.
36. UL, List of Inspected Fire Protection Equipment and Material.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Provide door hardware and accessories manufactured by firms specializing in the production of this type of Work and complying with specified standards of ANSI, BHMA, DHI, NFPA, HMMA, SDI and UL.
2. Provide door hardware from manufacturers who are members of BHMA and participate in BHMA certification programs.

B. Installer's Qualifications:

1. The door hardware installer shall have in his employ an architectural hardware consultant. The architectural hardware consultant shall be a member of the Door and Hardware Institute, (DHI), who has passed the DHI certification examine and successfully completed an apprenticeship program. The architectural hardware consultant shall be responsible for preparing door hardware schedules and Shop Drawings and be present at the Site for the purpose of checking and supervising the Work of the installer during the time of installation and adjustment of the door hardware Work, and shall prepare a written field report on status of completed door hardware installation as specified.
2. Submit name and qualifications of the installer to ENGINEER.

C. Architectural Hardware Consultant Qualifications:

1. A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations and electrified door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

D. Component Supply and Compatibility:

1. Finish hardware equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the finish hardware manufacturer.
3. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

E. Testing Agency Qualifications: The independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated in accordance with ASTM E 329, without delaying the Work.

F. Regulatory Requirements:

1. Provide door hardware for fire-resistance-rated openings in compliance with NFPA 80.
2. Provide only door hardware that has been tested, listed and labeled by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
3. Modify features of door hardware items specified, and provide additional accessories and features as required to meet UL and NFPA requirements, at no additional cost to the OWNER.
4. Codes: Comply with applicable requirements of codes.

- G. Source Quality Control:
1. Obtain each type of door hardware item from only one manufacturer.
 2. Provide door hardware schedule, for submission to, and for approval by, ENGINEER, prepared in compliance with DHI standards.
 3. Comply with specified BHMA standards.
- H. Requirements of Regulatory Agencies:
1. Provide finish hardware for fire-resistance-rated openings in compliance with NFPA 80.
 2. Provide only finish hardware that has been tested, listed and labeled by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
 3. Modify features of finish hardware items specified, and provide additional accessories and features as required to meet UL and NFPA 80 requirements, at no additional cost to the OWNER.
 4. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.
- I. Hurricane-Resistant Assemblies: Finish hardware required to comply with the Miami- Dade County Product Control Approval System or the Florida Building Code Approval System.
- J. Preconstruction and Keying Conference: Conduct conference at Project site to comply with requirements in Section 01 31 19.13, Preconstruction Conference. In addition to OWNER, CONTRACTOR, and ENGINEER, conference participants shall also include Architectural Hardware Consultant and OWNER's security consultant. Review methods and procedures related to electrified door hardware including, but not limited to, the following:
1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 2. Review sequence of operation for each type of electrified door hardware.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review required testing, inspecting, and certifying procedures.
 5. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. OWNER entities responsible for signing off on keying and authorization to allow copies of keys.
 - e. Address for delivery of keys.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Copies of the Door Hardware Schedule in the manner and format specified, complying with the actual construction Progress Schedule requirements (for each draft). Include explanation of abbreviations, symbols, and codes used to present scheduled information.
1) Prepare and submit Door Hardware Schedule in compliance with HDI standards.
- b. Based on the door hardware requirements specified, organize the final Door Hardware Schedule into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other Work (such as hollow metal frames) which may be critical in the Project Schedule. Furnish final draft of schedule after Samples, manufacturer's data sheets, coordination with Shop Drawings for other Work, delivery schedules and similar information have been completed and accepted.
- c. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
- d. Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
- e. Include a separate key schedule, showing clearly how OWNER'S final instructions on keying of locks have been fulfilled.
- f. Door Hardware Schedules are intended for coordination of the Work. Review and acceptance by ENGINEER does not relieve CONTRACTOR of responsibility to fulfill the requirements as shown and specified.

2. Product Data:

- a. Copies of manufacturer's data for each item of door hardware. Include whatever information may be required to show compliance with specified requirements, and include instructions for installation and for maintenance of operating parts and exposed finishes. Include mounting heights and locations for each item of door hardware. Provide ENGINEER with latest complete technical catalogue of all available door hardware manufactured by proposed manufacturers, even if manufacturer specified by ENGINEER is submitted by CONTRACTOR to perform the Work. Furnish templates to fabricators of other Work, which is to receive door hardware.

B. Informational Submittals: Submit the following:

1. Certificates:

- a. Certify that electrified door hardware, approved for use on types and sizes of labeled fire doors, complies with listed fire door assemblies.

2. Test and Evaluation Reports:

- a. Certified independent laboratory test reports for BHMA certification program and certification tests for each type of product specified.
 - 3. Site Quality Control Submittals:
 - a. Field Report: Architectural Hardware Consultant's Report.
 - 4. Qualifications Statements:
 - a. Installer.
- C. Closeout Submittals: Submit the following:
- 1. Operation and Maintenance Documentation: Upon completion of the Work, furnish five copies of detailed maintenance manuals, including the following information:
 - a. Product name and manufacturer.
 - b. Name, address, e-mail address and telephone number of manufacturer and local distributor.
 - c. Detailed procedure for routine maintenance and cleaning.
 - d. Detailed procedures for repairs such as dents, scratches and staining.
 - e. Parts identification manual and maintenance manuals for each piece of door hardware.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
- 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver all items of door hardware in manufacturer's original, undamaged packages, bearing accurate representation of the item within each package.
 - 3. Pack each piece of door hardware separately, complete with screws, keying, instructions and templates, tagged to correspond with items submitted on approved Shop Drawings and as specified.
- B. Storage and Protection:
- 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Provide secure storage area for door hardware items, secured by locks and accessible only to door hardware installer, ENGINEER and CONTRACTOR.
 - 3. Store door hardware in manufacturers' original packages.
- C. Acceptance at Site:
- 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Items that arrive in a damaged condition shall be removed from the Site and not offered again for acceptance. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: 3 years from date of Substantial Completion, except as follows:
 - a. Exit Devices: 2 years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.8 MAINTENANCE

- A. Maintenance Service
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
 - 2. Maintenance Service: Beginning at Substantial Completion, provide 6 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
 - 1. Where the door, shape, size, fire-resistance-rating, frequency of use, or function of a member receiving door hardware is such as to prevent, or make

unsuitable, the types of door hardware specified, furnish similar types having as nearly as practicable the same operation but of type or kind more appropriate to the design intention and requirements of governing authorities having jurisdiction at the Site. Clearly identify and highlight to ENGINEER all such required modifications on Shop Drawings submitted for approval.

2. If door hardware for any location is not specified, provide door hardware equal in design and quality to adjacent door hardware specified for comparable openings at no additional cost to OWNER.
3. Furnish door hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements, as necessary for proper installation and function.
4. Unless otherwise specified, comply with DHI, Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames and Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.

2.2 DETAILS OF CONSTRUCTION

A. General:

1. Hand of Door: The Drawings show the swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish each item of door hardware for proper installation and operation of the door swing as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with labels required by governing authorities having jurisdiction at the Site.
3. Base Metals: Produce door hardware units of the basic metal and forming method specified, using the manufacturer's standard metal alloy, composition, temper and hardness. Do not substitute materials or forming methods for those specified.
4. Fasteners: Manufacture door hardware to conform to published templates, generally prepared for machine screw installation. Do not provide door hardware, which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
5. Furnish screws for installation, with each door hardware item. Provide Phillips flat-head screws except as otherwise specified. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces on other Work, to match the finish of such other Work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
6. Provide fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of door hardware, base material or fastener.
7. Provide concealed fasteners for door hardware units, which are not exposed when the door is closed, except to the extent no standard manufacturer units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other Work under any condition, except where it is not possible to

adequately reinforce the Work and use machine screws or concealed fasteners of another standard type to satisfactorily avoid the use of through bolts.

8. Tools for Maintenance: Furnish two complete sets of specialized tools as required for OWNER'S continued adjustment, maintenance, removal and replacement of door hardware.

2.3 HARDWARE TYPES

A. Mortise Hinges:

1. Templates and Screws: Provide only template-produced units.
2. Base Metal: Except as otherwise specified, fabricate hinges from stainless steel and finish to match the latch and lock set.
3. Number of Hinges: Provide three hinges on each door leaf of less than 60-inches in height; provide one additional hinge for next 30-inches of door height or fraction thereof; provide two additional hinges for each 30-inches, or fraction thereof, for doors above 90-inches tall.
4. Hinge Size: Except as otherwise specified or as required to comply with UL and NFPA, provide hinges of the following sizes:
 - a. Interior Doors:
 - 1) Heavy Use, Maximum 36-Inches Wide: 4-1/2-inch heavy-weight (0.180-inches).
 - b. Exterior Doors, Maximum 36-Inches Wide: 4-1/2-inch heavy-weight (0.180-inch).
 - c. Wide Exterior and Interior Doors:
 - 1) Maximum 48-inches wide: 5-inch heavyweight (0.190-inch).
 - 2) Over 48-inches wide: 6-inch heavy weight (0.203-inch).
5. Types of Hinges: Provide full-mortise type, ball-bearing hinges, swaged for mortise applications, inner leaf beveled, square cornered, unless manufacturer's recommendations indicate that half-mortise, half-surface, full-surface or other type should be used for the frame and door type or condition.
6. Hinge Pins: Except as otherwise specified, provide hinge pins as follows:
 - a. Pins: Stainless steel.
 - b. Exterior Doors: Non-removable pins. Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed.
 - c. Tips: Slope ends of hinge barrel.
7. Conform to ANSI/BHMA A156.7.
8. Comply with UL, List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
9. Products and Manufacturers: Provide one of the following:
 - a. FBB 199, FBB 191 by Stanley Commercial Hardware, Division of The Stanley Works.
 - b. T4B3386, TB3313 by McKinney Products Company, an ASSA ABLOY Group company.
 - c. Or equal.

B. High-Security Mortise Lock Sets:

1. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with ADAAG.
2. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
3. Strikes: Provide manufacturer's standard wrought box strike, for each location and use shown. Provide stainless steel curved lip strikes, unless otherwise recommended by manufacturer, finished to match lock or latch set trim.
4. Lock Throw: Provide minimum of 3/4-inch anti-friction latch bolt and 1-inch dead bolt throw. Comply with UL requirements for throw of latch bolts and deadbolts on fire-resistance-rated openings.
5. Materials: Provide the following features and materials:
 - a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
 - e. Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
 - f. Escutcheon: 8-inches by 2-1/2-inches wide by 3/16-inches thick, minimum; stainless steel, US 32D.
 - g. Hubs: Sintered steel, copper infiltrated.
 - h. Lever with Stop Pin: Brass, plated to match stainless steel, with additional built-in stop to prevent over-torquing of lever.
 - i. All components shall be of marine quality, wherever possible.
6. Backset: 2-3/4-inches.
7. Modify specified locks and latches to comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
8. Latches and Locks for Means of Egress Doors: Comply with NFPA 101.
9. Electrified Locking Devices: BHMA A156.25.
10. Finish: US 32D satin.
11. Conform to ANSI/BHMA A156.13, Series 1000, Security Grade 1.
12. Products and Manufacturers: Provide one of the following:
 - a. High Security SL8800 Mortise Lockset with Augusta - AUSL Lever Handles and Trim by Yale Commercial Locks and Hardware, an ASSA ABLOY Group company.
 - b. ML2000 Series Mortise Lockset with Newport NSM Lever Handles and Trim by Corbin Russwin Architectural Hardware, an ASSA ABLOY Group Company.
 - c. Or equal.

C. Panic Exit Devices:

1. Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown to allow independent opening and closing of each leaf of double doors with panic exit devices; complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.

2. Lock Throws: Provide minimum of 3/4-inch latch bolt throw complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
3. Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown to allow independent opening and closing of each leaf of double doors with panic exit devices; complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
4. Lock Throws: Provide minimum of 3/4-inch latch bolt throw complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
5. Provide concealed vertical rod type exit device and mortise type exit devices as specified.
6. Provide the following features and materials:
 - a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
 - e. Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
 - f. Escutcheon: 8-inches by 2-1/2-inches wide by 3/16-inches thick, minimum; stainless steel, US 32D.
 - g. Hubs: Sintered steel, copper infiltrated.
 - h. Crossbar: Oval, seamless with interlocking expansion collets and roll pins; knurled, satin stainless steel, 0.062-inches minimum thickness, with steel reinforcing tube.
 - i. Concealed bolts: Minimum 1/2-inch diameter, stainless steel.
7. Backset: Provide minimum backset of 2-3/4-inches.
8. Finish: US 32D satin.
9. ANSI/BHMA: A156.3, Type 3 and Type 8, Grade 1; F08, entrance by lever, key locks or unlocks lever for entrances shown as accessible to people with disabilities as required by ADAAG; and F05, entrance by thumb piece, key locks or unlocks thumb piece.
10. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
11. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
12. Products and Manufacturers: Provide one of the following:
 - a. 1530-L8 (F) and -T8 (F) Series Mortise Exit Devices and 1520(F) CVR Concealed Vertical Rod Exit Devices; with Escutcheon Trim and Augusta - ASL Lever Handles and Thumbpiece/Handle/Cylinder Unit by Yale Commercial Locks and Hardware, an ASSA ABLOY Group company.
 - b. ED6600Series Mortise Exit Devices and ED 6800 Concealed Vertical Rod Exit Devices; with Escutcheon Trim and Newport – N4M Lever Handles

and D Grip T7M Thumb piece/Handle/Cylinder Unit by Corbin Russwin Architectural Hardware, an ASSA ABLOY Group company.

c. Or equal.

D. Cylinders and Keying System:

1. Review the keying system with OWNER'S and provide the type required (master, grandmaster or great grandmaster), either new or integrated with OWNER'S existing system.
2. Furnish all locks with manufacturer's cylinders for interchangeable-core pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these before Substantial Completion. Construction control keys and cores shall not be part of OWNER'S permanent keying system. Permanent cores and keys shall be furnished to OWNER prior to Substantial Completion.
3. Comply with the OWNER'S instructions for master keying and, except as otherwise specified, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
4. Permanent keys and cores shall be stamped with the applicable key mark for identification. These visual key control marks or codes shall not include the actual key cuts. Permanent keys shall also be stamped "DO NOT DUPLICATE".
5. Cylinder Material: Brass, bronze or Series 300 stainless steels.
6. Cylinder Features: Seven-pin, high-security, removable core.
7. Key Material: Nickel silver.
8. Key Quantity: Furnish three keys for each lock and five keys for each master and grandmaster system. Provide one extra key blank for each lock.

E. Overhead, Surface-Mounted, Door Closers:

1. Provide all doors, unless specifically shown or specified as being provided with floor-mounted or concealed overhead closers, with surface-mounted overhead door closers. Provide both active and inactive door leafs with closers.
2. Size of Units: Except as otherwise specified, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, and anticipated frequency of use.
3. Where parallel arms are specified, and for closers on exterior doors, provide closer unit one size larger than recommended for use with standard arms.
4. Use parallel arm arrangement for doors that would otherwise have the door closer appearing in finished corridors or entries.
5. Comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials, and NFPA 80. Modify closers specified as required.
6. Provide hold open feature for all non-fire-resistant-rated doors, unless otherwise specified.
7. Provide corner bracket mounting on exterior doors. Select all arms to clear weather-stripping, and overhead door holders.
8. Provide long arm to allow door to swing 180 degrees where long arm will eliminate floor-mounted stops.
9. Provide closers with spring power adjustment feature capable of increasing spring power 15 percent minimum in all closer sizes.

10. Provide individual regulating valves for closing and latching speeds, and separate adjustable back check valve.
11. Provide delayed closing action feature on all door closers. Position valve at top of closure.
12. Provide the following materials and features:
 - a. Full Metal Cover: Aluminum.
 - b. Case: Cast-iron.
 - c. Arms: Plated to match full metal covers.
 - d. Other Parts: Steel.
 - e. Extreme temperature fluid.
 - f. Security torx machine screws.
 - g. Ten-year warranty.
 - h. Provide manufacturer's optional corrosion protection.
13. Finishes: US 26D satin chrome. Color coordinate all arms and other accessories.
14. Highly Corrosive Atmospheres: Provide all closers with specified manufacturer's optional corrosion protection.
15. ANSI/BHMA: A156.4, C02011, in compliance with PT 1 and PT 4.
16. Products and Manufacturers: Provide one of the following:
 - a. DC8000 Series by Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - b. 4040 Series by LCN Closers, an Ingersoll Rand Company.
 - c. Or equal.

F. Flush Bolts:

1. Provide flush bolts on the inactive leaf of all pairs of doors, unless otherwise specified.
2. Provide flush bolts at the top and bottom of door.
3. Provide downset of 12-inches for all automatic flush bolts, and manufacturers' automatic flush bolt strikes, for the locations specified in List of Door Hardware Items at end of Part 3.
4. Comply with UL, Hardware, Automatic or Surface Bolts, and NFPA 80, for automatic flush bolt requirements.
5. Provide the following features and materials:
 - a. Automatic Flush Bolts: All parts bronze.
 - b. Flush Bolt Levers: Forged Brass.
 - c. Flush Bolt Plate: Forge Brass.
 - d. Flush Bolt Guide and Strike: Wrought Brass.
 - e. Flush Bolt Rods: 1/2-inch round rods, bronze, 12-inches minimum length.
 - f. Bolt Head: Brass.
6. Provide extension flush bolts with 3/4-inch throws and with top bolt not over 6 foot-0 inches above finished floor. Provide bottom flush bolt 12-inches long.
7. ANSI/BHMA: A156.16: L14081, L14251 and L14091.
8. Products and Manufacturers: Provide one of the following:
 - a. FB458 Extension Flush Bolts by IVES Hardware, an Ingersoll-Rand Corporation.

- b. Trimco 3917 Series Manual Exterior Flush Bolts by Triangle Brass Manufacturing Company.
- c. Or equal.

G. Coordinators:

- 1. Provide coordinator device on all pairs of doors required or specified to have automatic flush bolts, or panic exit devices. Comply with UL, List of Inspected Fire Protection Equipment and Material, and NFPA 80 requirements.
- 2. Provide manufacturer's standard units equipped with a safety release mechanism which allows the active leaf to close if under extreme pressure and whose active door lever, located nearest the active door stop, holds the active door ajar until the trigger mechanism is released to the retracted position by the closing of the inactive leaf.
- 3. Provide coordination and/or closure at door top to ensure that coordinator does not fall into door top recess or recess for flush bolt.
- 4. Materials: Anodized aluminum.
- 5. Finish: US 26D.
- 6. ANSI/BHMA: A156.3, BHMA 5.1, Type 21 and Type 21A.
- 7. Products and Manufacturers: Provide one of the following:
 - a. CORG7 Series Coordinator with FB Series Flush Bolts by IVES Hardware, an Ingersoll-Rand Company.
 - b. Trimco Series 3094 Coordinator by Triangle Brass Manufacturing Company.
 - c. Or equal.

H. Astragals:

- 1. Provide metal astragal bar, not less than 1/8-inch by 2-inches, for exposed flathead screw mounting on active leaf of all pairs of doors. Comply with UL and NFPA requirements for types and locations of astragals.
- 2. Provide astragal of extruded aluminum with clear anodized finish.
- 3. Products and Manufacturers: Provide one of the following:
 - a. No. 357 Series by Pemko Manufacturing Company.
 - b. No. 139 Series by National Guard Products.
 - c. Or equal.

I. Dust-Proof Strikes:

- 1. Provide brass dust-proof strikes, which incorporate a slotted plunger raised to flush position by spring tension for all flush bolts.
- 2. Provide 5/8-inch inside diameter dust-proof strikes; threshold mounted and surface mounted.
- 3. Finish: US 26D satin chrome.
- 4. ANSI/BHMA: A156.16, L14011-L14012.
- 5. Products and Manufacturers: Provide one of the following:
 - a. DP-1 and DP-2 by IVES Hardware, an Ingersoll-Rand Company.
 - b. Trimco Series 3910 and 3910N Dustproof Strikes by Triangle Brass Manufacturing Company.
 - c. Or equal.

J. Weatherstrip Gasketing:

1. Provide perimeter weather stripping at all exterior doors. Provide stripping and seals for interior doors where scheduled in List of Door Hardware Items at end of Part 3.
2. Continuity of Stripping: Except as otherwise specified, stripping at each opening shall be continuous and without unnecessary interruptions at door corners and hardware.
3. Replaceable Seal Strips: Resilient or flexible seal strip of every unit shall be easily replaceable and readily available from stocks maintained by the manufacturer.
4. Provide bumper-type weather-stripping at jambs and head, including a resilient insert and metal retainer strip, surface-applied, of the following metal, finish and resilient bumper material:
 - a. Housing: Extruded aluminum with clear anodized finish; 0.062-inch minimum thickness of main walls and flanges.
 - b. Dimensions: 1-3/8-inches by 7/8-inches, stop-mounted.
 - c. Seals: Closed-cell extruded silicone.
 - d. ANSI/BHMA: A156.22, R3E264.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) No. 2891 APK (for parallel arms) by Pemko Manufacturing Company.
 - 2) No. 429A (for parallel arms) by Zero International.
 - 3) Or equal.
5. Provide heavy-duty, surface-mounted, door-bottom sweep unit of manufacturer's standard design retained in an extruded metal bar and capable of closing a 3/4-inch gap (from door bottom to floor or threshold):
 - a. Housing: Extruded aluminum, 0.062-inch thick, with mill aluminum finish.
 - b. Seal: Eco-V.
 - c. Mounting: Surface-mounted.
 - d. ANSI/BHMA: A156.22, R3D534.
 - e. Products and Manufacturers: Provide one of the following:
 - a) No. 345AV for exterior doors with a No. 321CN on the interior face of exterior doors, and, No. 307AV for interior doors by Pemko Manufacturing Company.
 - b) Or equal.

K. Thermal Barrier Thresholds:

1. All exterior doors shall be provided with thermal barrier thresholds.
2. Metal: Extruded aluminum.
3. Surface Pattern: Fluted tread, manufacturer's standard.
4. Provide countersunk stainless steel screws and expansion shields.
5. Width: 5 1/8-inches wide and of length sufficient to span full width of rough openings, coped and scribed neatly at and around door frames.
6. Construction:
 - a. Two-piece, with rigid vinyl key complying with manufacturer's recommendations.
7. Profile: Provide manufacturer's unit, which conforms to the minimum size and profile requirements specified.

- a. For doors equipped with panic hardware, including floor bolts, provide profile with stop bar of proper size and shape to function as the strike plate for the floor bolts.
 - 8. Thickness: 1/2-inch.
 - 9. ANSI/BHMA: A156.21, J12100.
 - 10. Products and Manufacturers: Provide one of the following:
 - a. 252X2AFG by Pemko Manufacturing Company.
 - b. 625 A by Zero International.
 - b. Or equal.
- L. Sealants: Provide elastomeric sealant complying with FS TT-S-00227, Type 2 (non-sag) Class A for use with thresholds.

2.3 HARDWARE FINISHES

- A. Provide matching finishes for door hardware units at each door or opening, to the greatest extent possible in compliance with ANSI/BHMA A156.18.
- B. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of door hardware exposed at the same door or opening. In general, match all items to the manufacturer's standard finish for the latch and lock set for color and texture.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate to receive door hardware, and the conditions under which the Work will be performed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the door hardware Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Templates: Furnish door hardware templates to each fabricator of doors, frames and other Work to be factory-prepared for the installation of door hardware. Check the Shop Drawings of such other Work, to confirm that adequate provisions are made for the proper installation of the door hardware.
- B. Prepare Work to receive door hardware Work in compliance with ANSI/DHI A115.1.
- C. Surface-Applied Door Hardware: NFPA 80: Drill and tap doors and frames according to ANSI A250.6.

3.3 INSTALLATION

- A. Installer shall check and approve the installation before operation. Installer shall assure that the system operates to the OWNER'S satisfaction.
- B. Mount door hardware units at heights recommended in, Door and Hardware Institute, "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames" and "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames", except as otherwise specified or required to comply with governing authorities having jurisdiction at the Site, HMMA 830 and ADAAG requirements.
- C. Install each door hardware item in compliance with the manufacturer's instructions and recommendations and approved Shop Drawings. Wherever cutting and fitting is required to install door hardware onto or into surfaces that are later to be painted or finished in another way, install each item completely, then remove, and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.
- G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel that will not corrode in contact with the threshold metal.
- H. Set thresholds in a bead of elastomeric sealant to completely fill concealed voids and exclude moisture from every source. Do not plug drainage holes or block weeps. Remove excess sealant before sealant cures to a firm set.
- I. Initial Adjustment: Adjust and check each operating item of door hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with the type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- J. Final Adjustment: Where door hardware installation is made more than one month prior to Substantial Completion, return to the Work during the week prior to acceptance or occupancy, and make a final check and adjustment of all door hardware items in each space and area. Clean and re-lubricate operating items as necessary to restore proper function and finish of door hardware and doors. Adjust door control devices to compensate for final operating of heating and ventilating equipment.
- K. Provide manufacturer's authorized representative to instruct and train OWNER'S personnel in proper adjustment and maintenance of door hardware during the final adjustment of door hardware.
- L. Door hardware, which is blemished or defective, will be rejected even though it was set in place before defects were discovered. Remove and replace with new door hardware. Repair all resultant damage to other Work.
- M. Continued Maintenance Service: Approximately six months after the acceptance of door hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer, shall return to the Project and readjust every item of hardware to restore proper function of doors and door hardware. Consult with and instruct OWNER'S personnel in recommended additions to the maintenance procedures. Clean and lubricate operational items wherever required. Replace door hardware items that have deteriorated or failed due to faulty design, materials or installation of door hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the door hardware.

3.4 FIELD QUALITY CONTROL

- A. Provide a written field report, prepared by installer's architectural hardware consultant, identifying actual condition, location, manufacturer, and product designation for each item of door hardware actually present on each door at the Site, including whether door hardware is adjusted and operating properly, compared with each item referenced to approved Shop Drawings and Contract requirements.
- B. Installer's hardware consultant shall provide opinions to, and assist ENGINEER in determining, acceptability of installation as Work proceeds. All comments and discussions, conversations and meetings with ENGINEER shall be included in written field report for submission to ENGINEER for review and approval at completion of door hardware installation.
- C. As part of written field report to be submitted to ENGINEER for approval, recommend remedial actions for Work not in compliance with these Specifications.

No payment for Work shall be made until remedial recommendations and actions have been approved by ENGINEER and incorporated into the Work.

3.5 LIST OF DOOR HARDWARE ITEMS

- A. Scheduled items for each door are generic and rely on information specified above. The listing of hardware functions and types provided are only a general guideline for the final Door Hardware Schedule. CONTRACTOR shall submit a Door Hardware Schedule acceptable to all governing authorities having jurisdiction at the Site.
- B. Provide the following door hardware items:
 - 1. Flint River Pump Station, Electrical Building.
 - c. Door No. 101-1, Exterior, Double FRP Doors:
 - 1) Mortise Hinges.
 - 2) High-Security Mortise Locksets.
 - 3) Panic Exit Device (F05).
 - 4) Overhead, Surface-Mounted Door Closer on Active Door Only.
 - 5) Flush bolts.
 - 6) Weatherstrip Gasketing.
 - 7) Thermal Barrier Threshold.
 - 8) Closers on both doors.
 - 9) Cylinder and Keying.
 - 10) Coordinator.
 - 11) Astragals.
 - 12) Dust-proof strikes.

+ + END OF SECTION + +

SECTION 08 81 00

GLASS GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install glass glazing.
2. Extent of glass glazing is shown.
3. Types of products required include the following.
 - a. Tinted, Low-E, tempered, (hurricane-resistant), laminated, insulated, float glass.
 - b. Tinted, Low E, tempered, ceramic-coated, insulated, spandrel glass.
 - c. Miscellaneous glazing, gaskets, spacers, tapes, and other materials.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the glass glazing Work.

C. Related Sections:

1. Section 08 51 13, Aluminum Windows.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. AAMA, GDSG-1, Glass Design for Sloped Glazing.
2. AAMA, TIR-A7, Sloped Glazing Guidelines.
4. AAMA 806.3, Voluntary Specification for. Bonding-Type Back-Bedding Glazing Tapes.
5. ANSI Z97.1, Safety Glazing Materials Used in Buildings.
6. ANSI/ASTM E 1300, Practice for Determining Load Resistance of Glass in Buildings.
7. ASCE 7, Minimum Design Loads for Buildings and Other Structures.
8. ASTM C 509, Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
9. ASTM C 716, Specification for Installing Lock-Strip Gaskets and Infill Glazing Materials.
10. ASTM C 793, Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants.
11. ASTM C 794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
12. ASTM C 920, Specification for Elastomeric Joint Sealants.
13. ASTM C 963, Specification for Packaging, Identification, Shipment, and Storage of Lock-Strip Gaskets.

14. ASTM C 1021, Practice for Laboratories Engaged in Testing of Building Sealants.
15. ASTM C 1036, Specification for Flat Glass.
16. ASTM C 1048, Specification for Heat-Treated Flat Glass-Kinds HS, Kind FT Coated and Uncoated Glass.
17. ASTM C 1087, Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
18. ASTM C 1115, Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
19. ASTM C 1172, Specification for Laminated Architectural Flat Glass.
20. ASTM C 1249, Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazed Applications.
21. ASTM C 1330, Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
22. ASTM E 548, Guide for General Criteria Use for Evaluating Laboratory Competence.
23. ASTM E 1886, Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
24. ASTM E 1996, Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
25. ASTM E 2190, Specification for Insulating Glass Unit Performance and Evaluation
26. 16 CFR, Consumer Product Safety Commission, CPSC Part 1201, Safety Standard for Architectural Glazing Materials.
27. 40 CFR 59 Subpart D, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.
28. GANA, Glazing Manual.
29. GANA, Laminated Glazing Reference Manual.
30. GANA, Glass Tempering Division, GTA 95-1-31, Specification for Decorative Architectural Flat Glass.
31. GANA, Membership List.
32. IGCC, Certification Program.
33. IGMA Publication for Sloped Glazing: IGMA TB-3001, Guidelines for Sloped Glazing.
34. IGMA Publication for Insulating Glass: SIGMA TM-3000, North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
35. LBL-35298 Window 4.1, "A PC Program for Analyzing the Thermal Performance of Fenestration Products."
36. NFRC, Certification Program.
37. NFRC 100, Procedure for Determining Fenestration Product U-Factors.
38. NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
39. NFRC 300, Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
40. NGA, Glazier Certification Program.

41. UL Building Materials Directory.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in inches according to ASTM C 1036.
- C. Interspace: The space between lites of an insulating glass unit that contains dehydrated air or a specified gas.
- D. Sealed Insulated Glass Unit Surfaces:
 - 1. Side 1: Exterior surface of outer plane.
 - 2. Side 2: Interior surface of outer plane.
 - 3. Side 3: Interior surface of inner plane.
 - 4. Side 4: Exterior surface of inner plane.

1.4 QUALITY ASSURANCE

- A. Primary Glass Manufacturer and Glazing Materials Manufacturer Qualifications:
 - 1. Provide glass glazing materials manufactured by firms specializing in the production of the types of glass glazing products specified, in compliance with specified standards.
 - 2. Provide glass from manufacturers who are certified under NGA's Certified Glass Installer Program.
 - 3. Obtain glass glazing materials from manufacturers who will send a qualified technical representative to the Site, for the purpose of advising the installer of proper procedures and precautions for the use of the materials and who will assist Engineer with opinions on the acceptability of materials and Work.
- B. Fabricator Qualifications:
 - 1. Provide laminated and insulating glass fabrications from fabricators who are licensed by primary glass manufacturer to produce specified units and with documented skill and successful experience in this type of Work and who agree to employ only tradesmen who are trained, skilled and have successful experience in this type of Work.
 - 2. Provide laminated and insulating glass fabrications from fabricators who are members of GANA and participate in certification programs.
 - 3. Obtain laminated and insulating glass fabrications from fabricators who will, if required, send a qualified technical representative to the Site, for the purpose of assisting Engineer with opinions on the acceptability of materials and installation methods.
- C. Installer's Qualifications:
 - 1. The installer of the glass glazing materials shall be a firm with documented skill and successful experience in the installation of the types of materials

required and who agrees to employ only tradesmen who are trained, skilled and have successful experience in the types of materials and glazing systems specified and who are certified under the NGA Certified Glass Installer Program.

2. Submit records of experience and certifications to Engineer.
- D. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing specified, as documented according to NFRC CAP 1 Certification Agency Program.
- E. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct testing specified.
- F. Source Limitation: All materials provided under this Section, to the extent possible, shall be obtained from a single supplier or manufacturer who, with Contractor, shall assume full responsibility for the completeness of the Work. The supplier or manufacturer shall be the source of information on all material furnished regardless of the manufacturing source of that material.
- G. Source Limitations for Glazing Accessories: As much as possible, obtain from single source from single manufacturer for each product and installation method.
- H. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- I. Regulatory Requirements:
1. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 2. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to the glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg, and the fire-resistance rating in minutes
- J. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

- K. Codes: Comply with applicable requirements of codes referenced in Section 01 42 00, References.
- L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in Section 08 51 13, Aluminum Windows to match glazing systems required for Project, including glazing methods.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- M. Pre-Construction Meeting: Refer to Section 08 51 13, Aluminum Windows.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Plans and elevations showing location of each type and kind of glass specified and details of glazing system. Include manufacturer's recommendations for glazing.
 - b. Dimensions and details of manufacturer's glue line thickness and bite dimensions and verifications.
 - 2. Product Data:
 - a. Copies of manufacturers' specifications and installation instructions for each type of glass, glazing sealant or compound, gasket and associated miscellaneous material and all recommended installation precautions for required materials and components, which are not included in other submittals, specified in other Sections. Coordinate the submittal of such other data with this submittal, and with the submittal of samples required by other Sections.
 - b. Structural performance calculations indicating that detailing and fabrication have been based on the results of the required analysis and performance criteria specified.
 - c. Glass Schedule, listing types of glass and locations, similar to Article 3.11.
 - 3. Samples:
 - a. 12-inch square samples of each type of glass required.
 - b. Insulating glass samples need not be hermetically sealed, but edge construction, wavelength-selective interlayer and low-E coatings shall be included and identified. Include specially prepared samples with each interlayer film product's identity marked on film and incorporated into sample.
 - c. Submit 12-inch-long samples of each color for each type of exposed-to-view glazing sealant and gasket. Install sample between two strips of material similar to, or representative of, channel surfaces where sealant or gasket will be used, held apart to represent typical joint widths.

- d. Review of samples by Engineer will be for color, texture, and pattern only. Compliance with other requirements is the responsibility of Contractor.

B. Informational Submittals: Submit the following:

1. Certificates:

- a. Low-E glass fabricator shall provide a letter of compliance verifying performance characteristics of each glass unit.
- b. Certification that all glass materials subject to the applicable standards of the CPSC are in compliance. The certification shall be issued in conformance with procedures stated in the standard.
- c. Include primary glass manufacturer's and fabricator's published data, and letters of certification, based on certified test laboratory reports, indicating that each material complies with specified requirements and is acceptable for the applications shown.
- d. Certification that fabricated products comply with manufacturer's published performance.
- e. Age of silicone sealant.

2. Test Reports:

- a. Certified laboratory test reports for required performance tests in compliance with NFRC CAP 1 Certification Agency Program.
- b. Provide low-E glass manufacturer's computer-aided sheet engineering analysis to determine deflection and rabbet depth for individual applications, specified loadings, performance requirements, support criteria and other parameters, in order to indicate compliance with these Specifications.
- c. Low-E glass fabricator's computer performance analysis of each glass configuration including argon-filled interlayers for insulating glass units.
- d. Adhesion and compatibility test report from glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glazing channel substrates and for compatibility with glass and other glazing material.
- e. Performance analysis of each configuration of insulating glass incorporating wavelength selective interlayer or low E coating using LBL-35-298, Window 4.1.

3. Qualifications Statements:

- a. Manufacturer.
- b. Fabricator.
- c. Installer.
- d. Testing Agencies.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:

- a. Recommended inspection intervals.
- b. Instructions for repairing and replacing failed sealant joints.

2. Warranty Documentation:

- a. Manufacturer's and fabricator's guarantees, as specified.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Protect glass glazing materials according to manufacturer's and fabricator's written instructions to prevent damage to glass glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
 - 3. For insulating glass that will be exposed to substantial altitude changes, comply with insulating glass fabricator's written recommendations for venting and sealing to avoid hermetic seal ruptures.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.8 WARRANTY

- A. General: The special warranties specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.
- B. Special Warranties:
 - 1. Laminated Glass: Provide written warranty, signed by the fabricator and Contractor and running to benefit of Owner, agreeing to replace, for a period of ten-years from the date of Substantial Completion, glass units that show deterioration, as specified. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

2. Insulating Glass: Provide written warranty, signed by the fabricator and Contractor and running to the benefit of Owner, agreeing to replace, for a period of ten-years from the date of Substantial Completion, glass that shows signs of deterioration, as specified. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
3. Coated Glass: Provide written warranty, signed by the fabricator and Contractor and running to the benefit of Owner, agreeing to replace, for a period of ten-years from the date of Substantial Completion, glass that shows signs of deterioration, as specified. Defects include peeling, cracking, and other indications of deterioration in coating.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria: For glass performance, manufacture, size, type, construction and thickness, comply with the following:
 1. Provide glass glazing systems capable of withstanding normal thermal movements and wind and impact loads without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants (both structural and weather-resisting) to remain watertight, airtight and to maintain structural performance characteristics specified; deterioration of glazing materials; or other defects in construction.
 2. Normal Thermal Movement: Provide glass that allows for thermal movements resulting from a maximum temperature range of 120°F in ambient and 180°F surface temperature acting on glass framing members and glazing components. Base structural performance calculations on surface temperatures of materials caused by both solar heat gain and nighttime-sky loss.
 3. Comply with requirements of Consumer Product Safety Commission, Part 1201, Safety Standards for Architectural Glazing Materials and the applicable building code, for all the Work.
 4. Structural Performance: Provide structural calculations for analysis of required glass thicknesses for glass lites shown, that are used to establish final fabricating and detailing requirements. Indicate compliance with the following minimum criteria for all glass shown:
 - a. Project Wind Speed: 130 miles per hour (ultimate design wind speed), 101 miles per hour (allowable stress design wind speed) per the 2018 International Building Code with Georgia Amendments.
 - b. Risk Category III.
 - c. Exposure Category: Exposure D.
 - d. Components and Cladding Wind Pressure = 50 psf.
 - e. Short-Duration Load, Fga: In accordance with ASTM E1300.
 - f. Probability of Breakage for Vertical Glazing: Eight lites per 1,000 under wind action.

- g. Maximum Lateral Deflection: For glass supported on all four edges, provide thickness required to limit center deflection at design wind pressure to 1/50 times the short side length or 1-inch, whichever is less.
- 5. Glass thicknesses shown are minimums. Confirm glass thicknesses by analyzing Project structural loadings and in-service conditions using glass manufacturer's recommended load tables and other structural performance criteria specified. Where manufacturer's load tables indicate acceptability of lesser thickness material than required by performance criteria specified, provide specified thicknesses and features as a minimum. Where load tables indicate the need for greater thickness, or additional features, than specified, provide greater thicknesses and features at no additional cost to Owner. Comply with practice for determining minimum thickness and types of glass, to resist loadings required by governing authorities having jurisdiction at the Site, according to ANSI/ASTM E 1300.
- 6. Provide each configuration of insulating glass incorporating low-E coatings.
- 7. Glazing Sealant System Compatibility:
 - a. Glazing sealants shall be compatible with the channel surfaces, joint fillers, insulating glass sealing system, laminated glass interlayer material and other materials in contact with the glazing channel in compliance with ASTM C 1087.
 - b. Provide only materials and manufacturer's recommended variation of the specified materials, which are known to be fully compatible with the actual installation conditions, as shown by manufacturer's published data or certification submitted to Engineer for approval.
- 8. Adhesion of Elastomeric Joint Sealants: Comply with ASTM C 793 and ASTM C 794.
- 9. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer-aided software design, expressed as Btu/square foot by height by degree F.
- 10. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer-aided software design.
- 11. Solar Optical Properties: NFRC 300.

2.2 GLASS PRODUCTS, GENERAL

- A. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-strengthened float glass, or Kind FT fully tempered float glass as needed to comply with "Design Criteria" Article.
- B. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes enhanced-protection testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
 - 1. Large-Missile Test: For all glazing, regardless of height above grade.

- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 1/4-inch thick, minimum.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS

- A. Low-E, Tinted, Fully Tempered, Hurricane Resistant, Laminated, Insulated, Float Glass: Provide clear glass laminated in compliance with ASTM C 1172; meeting the requirements listed in Article 2.1 B.
1. Insulating Glass Units: Provide preassembled units consisting of two lites of glass separated by a dehydrated interspace, and complying with ASTM E 2190 for Class C units, permanently and hermetically sealed together at edges with spacers and sealant.
 2. System Sealing: Dual seal with polyisobutylene primary sealant and silicone secondary sealant, complying with ASTM C 1249.
 3. Overall Unit Thickness: 1 3/16-inch.
 4. Thickness of Each Glass Lite: 1/4 inch.
 5. Outdoor Lite: Low-E, tinted, fully tempered, float glass.
 6. Indoor Lite Kind: LA - Two or more lites of flat annealed transparent glass conforming to the applicable requirements of ASTM C 1036 and bonded by an interlayer material and as follows:
 - a. Outer Lite: Type I (transparent glass, flat), Class 1 (clear), Quality Q³ (glazing select); tempered, 1/4-inch thick, minimum.
 - b. Inner Lite: Type I (transparent glass, flat), Class 1 (clear), Quality Q³ (glazing select), tempered, 1/4-inch thick, minimum.
 7. Plastic Interlayer Material: 0.090-inch polyvinyl butyral sheet.
 8. Interspace Content: Argon.
 9. Low-E Coating: Pyrolytic on second surface.
 10. Visible Light Transmittance: 56 percent minimum.
 11. Winter Nighttime U-Factor: 0.35.
 12. Summer Daytime U-Factor: 0.30 maximum.
 13. Solar Heat Gain Coefficient: 0.35, maximum.
 14. Light to Solar Gain Ratio: 1.78
 15. Shading Coefficient: 0.41.
 17. Provide safety glazing labeling.

18. Products and Manufacturers: Provide one of the following:
 - a. PPG Sungate 500, Atlantica and StormGlass, Laminated, Insulated, Glass by Oldcastle Building Envelope.
 - b. Pilkington Energy Advantage, EverGreen and Sea Storm Laminated, Insulated, Glass by Cardinal Glass Industries.
 - c. Or equal.

- B. Low-E, Ceramic-Coated, Fully Tempered, Insulating, Spandrel Glass.
 1. Overall Unit Thickness: 1 inch.
 2. Thickness of Each Glass Lite: 1/4 inch
 3. Outdoor Lite: Fully Tempered float glass; Kind FT.
 4. Interspace Content: Argon.
 5. Indoor Lite: Fully Tempered spandrel glass; Kind FT.
 6. Low-E Coating: Pyrolytic on second surface.
 7. Opaque Coating Location: Fourth surface.
 8. Winter Nighttime U-Factor: 0.35 maximum.
 9. Summer Daytime U-Factor: 0.30 maximum.
 10. Products and Manufacturers: Provide one of the following:
 - a. PPG Sungate 500, Atlantica and Viraspan Insulated, Fully Tempered, Spandrel Glass by Viracon, Incorporated.
 - b. Pilkington Energy Advantage, EverGreen and Insulated, Fully Tempered, Spandrel Glass by Oldcastle Building Envelope.
 - c. Or equal.

2.4 GLAZING SEALANTS, TAPES AND GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, gaskets in compliance with ASTM C 1115, Type C.
 1. Products and Manufacturers: Provide one of the following:
 - a. Dense Silicone Wedge Gaskets SCR-900 by Tremco, Incorporated.
 - b. Or equal.

- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned silicone gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 963, black.
 1. Products and Manufacturers: Provide one of the following:
 - a. Stanlock Glazing Gaskets by Griffith Rubber Mills.
 - b. Or equal.

- D. Preformed Butyl Rubber Back-Bedding Mastic Glazing Tape:
 - 1. Preformed tape of polymerized butyl or mixture of butyl and polyisobutylene with inert fillers with built-in spacer of synthetic rubber, solvent-based with minimum 95 percent solids, non-sag consistency, tack-free time of 24 hours or less, paintable, non-staining, complying with AAMA 806.3.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Polyshim II Glazing Tape by Tremco, Incorporated.
 - b. Or equal.
- E. Exterior, One-Part, Silicone Rubber Sealant:
 - 1. Silicone rubber-based, one-part elastomeric sealant, complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT, M, G, A and O.
 - 2. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Spectrem I by Tremco, Incorporated.
 - b. 860 Architectural Silicone Sealant by Pecora Corporation.
 - c. Or equal.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standards, requirements of manufacturers of glass glazing materials for applications shown, and approved Shop Drawings. Provide materials with a proven record of compatibility with surfaces shown and specified.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers and Edge Blocks: Elastomeric blocks or continuous extrusions, with a Shore A durometer hardness recommended by glass manufacturer to maintain lites in place and to limit lateral movement for installation shown, and with proven compatibility with sealants used in the Work.
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Cleaners, Primers and Sealers: Type recommended by sealant, gasket and glass manufacturer.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire- protection rating indicated.

2.6 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Glass manufacturer's recommended glazing channel dimensions are intended to provide for necessary minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. Contractor shall be responsible for correct glass size for each opening, within the tolerances and necessary dimensions established on approved Shop Drawings.

2.7 TOLERANCES

- A. Allowable Tolerances: Provide fully tempered and heat-strengthened glass, formed by horizontal roller-hearth process, free of tong marks, and not exceeding the following flatness tolerances (either face, any direction, any location) based on 1/4-inch glass thickness with inversely proportionate tolerances for other thicknesses:
 - 1. For 12-inch Run: 1/16-inch bow.
 - 2. For 3-foot Run: 1/8-inch bow.
 - 3. For 7-foot Run: 1/4-inch bow.
 - 4. For 10-foot Run: 3/8-inch bow.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glass glazing is to be performed, and notify Engineer, in writing, of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the glazing until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.
 - 1. Examine for compliance with the following:
 - a. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - b. Presence and functioning of weep systems.
 - c. Minimum required face and edge clearances.
 - d. Effective sealing between joints of glass-framing members.

3.2 PREPARATION

- A. Clean the glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings, which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.
- B. Apply primer or sealer to joint surfaces wherever recommended by sealant and glass manufacturer.

- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by

gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.9 FIELD QUALITY CONTROL

- A. Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and air-tight, deterioration of glazing materials and other defects in the Work.
- B. After nominal cure of exterior glazing sealants, which are exposed to the weather, test for water leaks. Flood the joint exposure with water directed from a 3/4-inch hose held perpendicular to wall face, 2 foot-0 inches from joint, connected to a water system with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 foot-0 inches per minute.
- C. Test approximately five percent of total glazing system, in locations which are typical of every joint condition, and which can be inspected easily for leakage on opposite face. Conduct tests in the presence of Engineer, who will determine the actual percentage of joints to be tested and the actual period of exposure to water from the hose, based upon the extent of observed leakage, or lack thereof.
- D. Repair glazing installation at leaks or, if leakage is excessive, replace glazing sealants as directed by Engineer.
- E. Wherever nature of observed leakage indicates the possibility of inadequate glazing joint bond strength, Engineer may direct that additional testing be performed at a time when joints have been fully cured, followed by natural exposure through both extreme temperatures, and returned to the range of temperature in which it is feasible to conduct testing. Repair or replace Work as required and directed by the Engineer.

3.10 GLASS SCHEDULE

- A. Exterior Windows (hurricane resistance):
 - 1. Tinted, low-e, fully-tempered, laminated, insulated float glass. Provide at locations to match existing.
 - 2. Ceramic-coated, low-e, fully-tempered, laminated, insulated spandrel glass. Provide at locations to match existing.

++ END OF SECTION ++

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SCOPE

- A. This Section of the Specifications includes, but is not necessarily limited to, standards for cleaning and painting structures and equipment described in the Drawings and Specifications. Furnish all materials, equipment, and labor necessary to complete the Work.
- B. Section includes:
 - 1. Surface preparation to receive finishes.
 - 2. Priming and backpriming interior and exterior finish carpentry.
 - 3. Painting, staining, or otherwise finishing of all surfaces.
 - 4. Finishing millwork.
- C. Related Work Specified Elsewhere
 - 1. Section 03055, Concrete.
 - 2. Section 05120, Structural Steel.
 - 3. Section 05500, Miscellaneous Metal.
 - 4. Section 15050, Basic Mechanical Materials and Methods.
 - 5. Section 15060, Piping and Appurtenances.

1.2 SUBSTITUTIONS

To the maximum extent possible, similar coatings shall be the products of one manufacturer. Guidelines for determination of acceptability of product substitutions are given in Instructions to Bidders. Contractors intending to furnish substitute materials or equipment are cautioned to read and comply strictly with these guidelines.

1.3 SUBMITTALS

- A. All submittals and storage and protection provisions shall be in accordance with the requirements of the General Conditions, and the following.
 - 1. Product data:
 - a. Submit complete list of products for use; indicate compliance with:
 - 1) Mercury-free composition limits.
 - 2) VOC limits, when mixed and thinned.
 - 3) Indicate lead content.
 - b. Indicate manufacturer, brand name, quality, and type paint for each surface to be finished; correlate to specified item if from other manufacturer than specified item. Refer to the

- b. Indicate manufacturer, brand name, quality, and type paint for each surface to be finished; correlate to specified item if from other manufacturer than specified item. Refer to the attached sample Paint Submittal Schedule for required submittal format.
 - c. Include specified manufacturer's data sheets for reference to submitted manufacturer's data sheets.
 - d. Manufacturer's Safety Data Sheets (MSDS) for materials.
 - e. Intent of Contractor to use products specified does not relieve him from responsibility of submitting product line.
2. Samples:
- a. Color samples: Submit two sets of color samples from paint manufacturers proposed for use for color selections by Engineer.
 - b. Brush-outs:
 - 1) Prepare actual brush-outs for each color paint, stain, or finish following final color schedule issuance.
 - 2) Submit brush-outs in duplicate: minimum size, 120 sq. in.
 - 3) Apply products in number of coats specified for actual Work.
 - 4) Provide following substrates for brush-outs:
 - a) Concrete unit masonry: Paint one face to simulate concrete and masonry.
 - b) Hardboard to simulate drywall, lumber, board products, and metals for paint finish.
 - c) Actual species and grade of wood specified for transparent finish.
3. Quality control submittals:
- Certificates:
- a. Indicate interior paints and stains are mercury-free.
 - b. Indicate lead content. Lead content in excess of 0.06% by weight of nonvolatile content calculated as lead metal is prohibited.
 - c. Indicate compliance with applicable VOC limits when mixed and thinned.

1.4 PROJECT MEETING

Prior to ordering any of the materials covered under this Section, the Contractor, Engineer, painting subcontractor, and paint manufacturer's representative shall attend a progress meeting in accordance with the General Conditions, and review the Work to be performed under this Section.

1.5 PAINTING REQUIREMENTS

Finish paint all exposed surfaces except anodized or lacquered aluminum, fiberglass reinforced plastic, stainless steel and copper surfaces. Items to be left unfinished or to receive other types of finishes are specifically shown on the Drawings or specified.

A. Unpainted Products: Full field cleaning and priming will be performed in accordance with specification requirements for unpainted products. Maintain adequate equipment on the site to assure proper cleaning.

B. Shop Primed Products:

1. Manufactured products may be shop cleaned and primed. Shop cleaning must equal or exceed cleaning specified in the Painting Schedule. Clean as specified and reprime all abrasions, weld splatter, excessive weathering, and other defects in the shop prime coating.
2. Manufacturers furnishing shop primed products shall certify that cleaning was performed in accordance with specification requirements and that the specified primer was used.
3. Fully field clean and prime any shop primed products which the Engineer determines that were not cleaned in accordance with the Specifications prior to priming, that the wrong primer was applied, that the primer was applied improperly, or has excessively weathered, or the product is otherwise unacceptable.

C. Finish Painted Products:

Certain products such as electrical control panels and similar items may, with the approval of the Engineer, be furnished finish painted. Properly protect these products throughout the project to maintain a bright and new appearance. If the finish surfaces are defaced, weathered, or not of the selected color, repaint as necessary in accordance with the paint system manufacturer's written recommendations.

D. Hardware:

Remove all electrical plates, surface hardware, fittings and fastenings prior to painting operations. These items are to be carefully stored, cleaned and replaced upon completion of Work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.

1.6 SEQUENCING AND SCHEDULING

A. Schedule and coordinate this Work with other trades and CONTRACTORS for other bid packages; proceeding until other Work and job conditions are proper to achieve satisfactory results is prohibited.

- B. Examine specification sections for various other trades; be thoroughly familiar with Work required in other sections regarding painting.

PART 2 - PRODUCTS

2.1 MATERIAL SCHEDULE

Material schedules list pretreatment coats, wash coats, seal coats, prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

2.2 APPLICATION DATA

All applicable data currently published by the paint manufacturer relating to surface preparation, coverages, film thickness, application technique, drying and overcoating times is included by reference as a part of this Section. It will be the responsibility of the Contractor to obtain and fully understand the appropriate data sheets for the coatings specified.

2.3 MATERIALS

- A. Paints shall be factory mixed and delivered to the job in unbroken original packages bearing the manufacturer's name and brand designation and shall be applied in strict accordance with the manufacturer's printed specifications. Two-component coatings shall be mixed in accordance with manufacturer's instructions. All two-component coatings, once mixed, shall be applied within the pot-life recommended by the manufacturer.
- B. Unless otherwise specified, paints shall be of the best grade. All thinners, driers, varnish, etc., shall be of the best grade and shall be furnished by the coating manufacturer for use with the specified paints.
- C. Paint thinners and tints: Products of same manufacturer as paints or approved by paint manufacturer for use with paint.
- D. Shellac, turpentine, patching compounds, and similar materials required for execution of Work: Pure, best quality products.

2.4 COLORS

- A. The Engineer will select the colors to be used on the various portions of the Work. Provide color cards for the coatings proposed. Where more than one coat of paint is required, job tint the paint for each undercoat off-shade to show complete coverage.

- B. Paint inside of ductwork flat black for entire area visible through ceiling openings. Paint underside of ductwork and other above ceiling items flat black for entire area visible through ceiling openings.
- C. Paint exposed pipes and ductwork same as adjacent ceiling surfaces.

2.5 SHOP PAINTING

- A. Collectors, motors, ferrous metal surface, appurtenances, etc., shall be primed and painted at the factory before shipment. Supplier shall provide touch up paint for field touch-up after installation. Painting system shall be by Tnemec Company, Inc. or OWNER approved equal.
- B. Surface preparation and painting shall conform to the requirements listed below in paint schedule in Section 3.7.
- C. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.
- D. Installing CONTRACTOR shall be responsible for the touch up painting.

PART 3 - EXECUTION

3.1 GENERAL

- A. Adequately protect other surfaces from paint and damage. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Repair damage as a result of inadequate or unsuitable protection.
- B. Protection: Cover finished Work of other trades, surfaces not being painted concurrently, and prefinished items.
- C. Application of materials in spaces where dust is being generated is prohibited.

3.2 PRODUCT HANDLING

- A. Delivery
 - 1. Deliver materials in original, sealed containers of the manufacturer with labels legible and intact.
 - 2. Each container shall be clearly marked or labeled to show paint identification, paint type and color, date of manufacture, batch number, analysis or contents, identification of all toxic substances, and special instructions.

B. Storage

1. Store only acceptable project materials on the project site.
2. Store material in a suitable location and in such a manner as to comply with all safety requirements including any applicable federal, state and local rules and requirements. Storage shall also be in accordance with the instructions of the paint manufacturer and the requirements of the insurance underwriters.
3. Restrict storage area to paint materials and related equipment.
4. Place any materials which may constitute a fire hazard in closed metal containers and remove daily from the project site.
5. Maintain neat, clean conditions in storage area; remove used rags from work areas at end of each day's work; store rags in closed containers.
6. Close containers at end of each day's Work. Leave no materials open.
7. Safety precautions:
 - a. Provide temporary fire protection equipment in materials storage area. Mark fire protection equipment location for quick access.
 - b. Prohibit smoking in storage area; post signs in visible location adjacent to and within storage area.

3.3 CLEANING AREA

Construct a temporary shed no smaller than 40 feet wide and 60 feet long for field cleaning, including blasting and priming operations. Maintain this area for all non-fixed painting operations until all such work has been completed and approved. Provide all fixtures and appurtenances required to perform the work including fixtures to support the work off the ground and proper storage facilities.

3.4 ENVIRONMENTAL CONDITIONS

Environmental conditions which affect coating application include, but are not necessarily limited to, ambient air temperature, surface temperature, humidity, dew point and environmental cleanliness. Comply with the manufacturer's recommendations regarding environmental conditions under which coatings may be applied.

3.5 SURFACE PREPARATION

- A. General: All surfaces shall be thoroughly clean, dry, and free from oil, grease or dust. All fabricated metal products shall have all weld flux and weld spatter removed and sharp peaks in weld ground smooth. The Engineer will inspect the surface preparation prior to the application of coatings. If the preparation is found to be satisfactory, a written order will be given to proceed with coatings.

- B. Lumber, plywood, and veneered surfaces:
1. Apply shellac, maximum four lb. cut to knots, pitch, and resinous sapwood prior to application of first paint coat.
 2. Surfaces to be painted: Fill nail holes, cracks, joints, and defects with spackling compound. Apply after first coat of paint.
 3. Sand surfaces smooth, except where rough-sawn surfaces are indicated. Dust to remove debris.
 4. Treat mildewed surfaces with solution of one quart hypochlorite bleach, one tablespoon laundry detergent, and three quarts water. Rinse and allow to dry prior to painting.
 5. Previously painted surfaces: Remove dirt, debris, and chalking by washing with detergent and water or low pressure cold water spray. Dull glossy surfaces by light sanding. Remove loose paint and blisters by scraping and sanding.
- C. Gypsum board:
1. Fill narrow, shallow cracks and small holes with patching plaster or non-shrinking spackling compound. Allow to dry; sand smooth without raising gypsum board paper nap.
 2. Wall surfaces designated to receive semi-gloss or gloss finish: Roll apply batter consistency mixture of gypsum board joint compound and water to surfaces; remove immediately with wide broadknife, without leaving ridges or gouges in finished surface. Allow to dry prior to prime coat application, Or;
Apply U.S. Gypsum Company, Sheetrock First Coat at 300-500 SF per gallon in accord with manufacturer's installation instructions. Allow to dry prior to prime coat application.
- D. Ferrous Metals: Standards for the surface preparation of ferrous metals required in the Material Schedules are the standards of the Steel Structures Painting Council (SSPC, SP-1 through SP-10). Inspection of these surfaces will be evaluated by field comparison with visual comparator panels. These panels shall be securely wrapped in clear plastic and sealed to protect them from deterioration and marring.
- E. Galvanized metal: Wash with xylol to remove grease, oil, and contaminants; wipe dry with dry cloth.
- F. Aluminum: Sand to remove oxides. Wash with xylol to remove grease, oil, and contaminants; wipe dry with dry cloth.
- G. Concrete Surfaces:
1. Fill cracks, holes, and irregularities with cement grout.
 2. Remove laitance, oil, grease, dirt, and debris from surfaces. Verify concrete cure time prior to coating application.
 3. For all concrete surfaces, the following surface preparation shall be employed:

CC-I - Wash: Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush away all soap and dirt with clean water. After this washing the surface will be rechecked and any rough areas not suitable for painting shall be sand blasted smooth.

3.6 APPLICATION

A. Conditions: No paint shall be applied upon damp or frosty surfaces, or in wet or foggy weather. No paint shall be applied in temperatures below 40.0 F. or when freezing (32.0 F.) is predicted within 24 hours of application, or under temperature or humidity conditions not recommended by the manufacturer.

B. Surface Preparation: After specified surface preparation, all surfaces shall be brushed free of dust or foreign matter. Surfaces shall be completely dry before any paint is applied.

Apply materials only when moisture content of surfaces is within manufacturer's recommended range.

C. Application: Paint shall be evenly spread in the proper thickness so that there shall be no drops, runs or sagging of the coating. Where runs and drops do occur, they shall be removed and the surface re-coated to the satisfaction of the Engineer. Sufficient time, as directed by the manufacturer, shall be allowed for the paint to dry before the application of succeeding coats.

1. Apply materials in accord with manufacturer's approved product data to achieve specified DFT.
2. Apply materials using clean brushes, rollers, or spray equipment. Limit paint spraying only to those materials recommended by manufacturer to be sprayed with no loss of performance, durability, or color.
3. Apply materials at rate not exceeding manufacturer's recommendations for surface being coated, less ten percent for losses.
4. Sand and dust between coats to remove defects visible from 5' - 0" distance. Tint primer and intermediate coats slightly to provide slight contrast.
5. Finish coats: Smooth, free of brush marks, streaks, laps or pile-up of paint, skips, or missed areas.
6. Make coating edges adjoining other materials or colors sharp and clean without overlapping.
7. Primer coats may be omitted for surfaces specified to receive factory applied primer if finish coats are compatible with primer. Substitute bond coat recommended by paint manufacturer for specified primer coat if finish coats are not compatible.

8. Refinish entire partition surface where portion of finish on gypsum board partition is damaged or unacceptable.
 9. Backprime exterior and interior finish carpentry and millwork with material specified for prime coat without runs on face; finish cut edges just prior to installation.
 10. Seal interior doors' tops and bottoms of with prime coat only; side edges same as faces.
 11. Finish exterior door edges same as exterior faces.
- D. Protection of Work Area: Use drop cloths or other suitable means to protect other surfaces of the structure or equipment in place. Upon completion of the Work, remove all paint spots from surfaces as directed by the Engineer.
- E. Inspection: The Engineer will inspect each coat prior to the application of subsequent coats. If the work is found to be satisfactory, a written order will be given to proceed. Application of additional coats until completed coat has been inspected is prohibited. Only inspected coats of paint will be counted in determining the number of coats applied.
- F. Defective Work: Remove and replace, at the direction of the Engineer, any painting work found to be defective or applied under adverse conditions.

3.7 PAINTING SCHEDULE

- A. Paint the following items as indicated below.
1. Exhaust fan enclosures on roof;
 2. Walls and ceiling surfaces affected by improvements to achieve complete coverage;
 3. Ductile iron pipe;
 4. All metal pipe supports;
 5. Chemical containment area and pump platform; and
 6. Exposed PVC piping.
- B. Surfaces not requiring painting:
1. Face brick;
 2. Precast concrete (unless otherwise noted);
 3. Stainless steel and titanium items;
 4. Prefinished surfaces and items; and
 5. Concealed ductwork, conduit, and piping.

Painting Schedule

Surfaces	Substrate Materials	Paint Material/Schedule
Ceilings	Exposed Concrete	131
Walls	Concrete	131
	CMU Block	131
Interior Structural Steel	Galvanized Metal	140
	Ferrous Metal	140
All Other Listed Metal Surfaces	Galvanized Metal	141
	Ferrous Metal	141
PVC Roof Drain Piping and Vent Stacks	Polyvinylchloride	150
DI Pipe	Ductile Iron	141
Copper Pipe	Copper	142
Tank Containment Area and Pump Platform	Concrete	132
Circular Thickening Equipment	Submerged Steel	161
Circular Thickening Equipment	Non-submerged Steel and Ferrous Metals	162

MATERIAL SCHEDULE 131

TYPE: EPOXY

USE: INTERIOR MASONRY AND CONCRETE

SURFACE PREPARATION: CC-I

TNEMEC

FIRST COAT: SERIES 130-6602 ENVIORFILL – 60-80 SQ/FT./GAL

SECOND COAT: SERIES 66HS HI-BUILD EPOXOLINE - 4.0 MILS DRY

THIRD COAT: SERIES 66HS HI-BUILD EPOXOLINE - 4.0 MILS DRY

* MINIMUM 8.0 MILS DRY

KOPPERS

FIRST COAT: CONCRETE AND MASONRY FILLER

SECOND COAT: HI-GARD EPOXY - 4.0 MILS DRY

THIRD COAT: HI-GARD EPOXY - 4.0 MILS DRY

* MINIMUM 8.0 MILS DRY

NOTES:

1. IF MINIMUM MIL THICKNESS IS NOT ACHIEVED IN NUMBER OF COATS SHOWN, ADDITIONAL COATS WILL BE APPLIED AT NO ADDITIONAL EXPENSE TO CITY.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. SHERWIN-WILLIAMS COMPANY.

MATERIAL SCHEDULE 132

TYPE: REINFORCED MORTAR NOVOLAC EPOXY LINING

USE: CONTAINMENT AREA AND PUMP PLATFORM

SURFACE PREPARATION: ABRASIVE BLAST TO PROVIDE PROFILE PER NACE 6/
SSPC-SP-13

TNEMEC

FILLER: SERIES 218 MORTARCLAD OR MORTARCAST

PRIMER: SERIES 2395C

BASE COAT: SERIES 2395C MORTAR, MAT AND SATURANT

TOP COAT : SERIES 282 (2 COATS)

NOTES:

1. IF MINIMUM MIL THICKNESS IS NOT ACHIEVED IN NUMBER OF COATS SHOWN, ADDITIONAL COATS WILL BE APPLIED AT NO ADDITIONAL EXPENSE TO CITY.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. KOPPERS,
 - b. SHERWIN-WILLIAMS COMPANY.

MATERIAL SCHEDULE 140

TYPE: POLYAMIDE EPOXY

USE: FERROUS METAL SURFACES AND STRUCTURAL STEEL LOCATED INSIDE A BUILDING WHICH ARE NOT SUBMERGED OR LOCATED ABOVE A LIQUID. NOT FOR USE WITH PROCESS EQUIPMENT.

SURFACE PREPARATION: SSPC SP-6

TNEMEC

PRIMER: SERIES 1 OMNITHANE – 2.0 – 5.0 MILS*

FIRST COAT: SERIES 66HS EPOXOLINE II - 6.0 - 8.0 MILS*

SECOND COAT: SERIES 66HS EPOXOLINE II - 6.0 - 8.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 14.5 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. KOPPERS,
 - b. SHERWIN-WILLIAMS COMPANY.

MATERIAL SCHEDULE 141

TYPE: HIGH BUILD EPOXY

USE: PROVIDE THE FOLLOWING COATING SYSTEM FOR FERROUS METAL SURFACES ON ALL MECHANICAL EQUIPMENT AND ACCESSORIES INCLUDING BUT NOT LIMITED TO: PUMPS, VALVING AND OTHER PROCESS EQUIPMENT AND EXTERIOR STRUCTURAL STEEL AND EXPOSED STEEL PIPE.

SURFACE PREPARATION: SSPC-SP10 NEAR WHITE BLAST-IMMERSION SERVICE

TNEMEC

FIRST COAT: SERIES 94H-20 TNEME-ZINC 2.5-3.5 MILS DRY

SECOND COAT: SERIES 66HS HI-BUILD EPOXOLINE 4.0-6.0 MILS DRY

THIRD COAT: SERIES 66HS HI-BUILD EPOXOLINE 4.0-6.0 MILS DRY

* MINIMUM TOTAL DRY FILM THICKNESS 10.5 MILS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS IS NOT ACHIEVED IN THE NUMBER OF COATS SHOWN, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. KOPPERS,
 - b. SHERWIN-WILLIAMS COMPANY.

MATERIAL SCHEDULE 142

TYPE: EPOXY

USE: PROVIDE THE FOLLOWING COATING SYSTEM FOR COPPER PIPING.

SURFACE PREPARATION: SSPC-SP1 SOLVENT CLEANING

TNEMEC

FIRST COAT: SERIES 66HS HI-BUILD EPOXOLINE 2.0-3.0 MILS DRY

SECOND COAT: SERIES 73U ENDURA-SHIELD 2.0-3.0 MILS DRY

* MINIMUM TOTAL DRY FILM THICKNESS 5.0 MILS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS IS NOT ACHIEVED IN THE NUMBER OF COATS SHOWN, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. KOPPERS,
 - b. SHERWIN-WILLIAMS COMPANY.

MATERIAL SCHEDULE 150

TYPE: ACRYLIC LATEX

USE: ALL PVC SURFACES TO BE PAINTED, AS SPECIFIED OR SHOWN ON DRAWINGS.

SURFACE PREPARATION: CLEAN AND DRY.

GLIDDEN

FIRST COAT: GLID-GUARD LIFEMASTER NO. 6900 SERIES - 2.0 MILS*

SECOND COAT: GLID-GUARD LIFEMASTER NO. 6900 SERIES - 2.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 4.0 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. BENJAMIN MOORE COMPANY,
 - b. DEVOE AND REYNOLDS COMPANY, INC.,
 - c. PRATT AND LAMBERT, INC.,
 - d. PPG INDUSTRIES, INC.,
 - e. SHERWIN-WILLIAMS COMPANY.

MATERIAL SCHEDULE 161

TYPE: EPOXY

USE: SUBMERGED STEEL OF CIRCULAR THICKENING EQUIPMENT

SURFACE PREPARATION: SSPC-SP10 / NACE 2

TNEMEC

PRIMER: SERIES 66HS HI-BUILD-EPOXYLINE – ONE COAT, MIN.
4.0 DRY MILS

INTERMEDIATE COAT: SERIES 66HS HI-BUILD EPOXOLINE – ONE COAT, MIN
8.0 TO 15.0 DRY MILS

FINISH COAT: SERIES 66HS HI-BUILD EPOXOLINE - ONE COAT, MIN
8.0 TO 15.0 DRY MILS

NOTES:

1. IF MINIMUM MIL THICKNESS IS NOT ACHIEVED IN NUMBER OF COATS SHOWN, ADDITIONAL COATS WILL BE APPLIED AT NO ADDITIONAL EXPENSE TO CITY.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. KOPPERS,
 - b. SHERWIN-WILLIAMS COMPANY.

MATERIAL SCHEDULE 162

TYPE: EPOXY

USE: NON-SUBMERGED STEEL AND FERROUS MATERIALS OF CIRCULAR THICKENING EQUIPMENT

SURFACE PREPARATION: SSPC-SP6 / NACE 3

TNEMEC

PRIMER: SERIES 66HS HI-BUILD-EPOXYLINE – ONE COAT, MIN. 4.0 TO 6.0 DRY MILS

INTERMEDIATE COAT (LOW TEMPERATURE CURING CONDITIONS): SERIES 161HS TNEME FASCURE – ONE COAT, MIN 6.0 DRY MILS

INTERMEDIATE COAT (WARM TEMPERATURE CURING CONDITIONS): SERIES 66HS – ONE COAT, MIN 6.0 DRY MILS

FINISH COAT: SERIES 72 ENDURA-SHIELD- TWO COATS, MIN 2.0 TO 3.0 DRY MILS

NOTES:

1. IF MINIMUM MIL THICKNESS IS NOT ACHIEVED IN NUMBER OF COATS SHOWN, ADDITIONAL COATS WILL BE APPLIED AT NO ADDITIONAL EXPENSE TO CITY.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. KOPPERS,
 - b. CARBOLINE.

+++ END OF SECTION +++

SECTION 10440

SIGNS & IDENTIFYING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Contractor shall furnish all the materials for and shall properly erect and install all identifying devices at the locations shown and as indicated on the Drawings, and as specified herein.
- B. This shall include all identification signs and warning signs, including supports, fastening devices, and accessories, and all labor, materials, tools, and appurtenances required to complete the Work.
- C. It is the intent of this Specification that the installation shall be complete in all respects and ready for use. The Contractor shall be responsible for all incidental details and for any special construction necessary to complete the work in an acceptable manner.
- D. Related Work Specified Elsewhere:
 - 1. Section 15060, Piping and Appurtenances.

1.2 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.
- B. Samples: Submit samples of each sign form and materials showing finished, colors, surface textures and qualities of manufacturer and design of each sign component including graphics.

1.3 QUALITY ASSURANCE:

- A. Uniformity of manufacturer: For each sign form and graphic image process indicated furnish products of single manufacturer.
- B. Quality of signage shall be not less than ASI-SPE construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Identifying devices shall be of the type and materials specified for each category. Unless otherwise indicated, signs shall be the manufacturer's stock items.

- B. Life Safety Signs: Signs shall be butyrate with red lettering on white background, and conforming to OSHA regulations.
1. FIRE EXTINGUISHER: Located above all extinguishers.
 2. DANGER - DO NOT DRINK THIS WATER: Located at each non - potable water station.
 3. DANGER - CONFINED SPACE ENTRY- ENTER BY PERMIT ONLY: Mounted near all confined spaces. (White background, red and black letters, 14" x 20").
 4. CAUTION – SLIPPERY SURFACE – located near all Polymer System areas
 5. LOW CLEARANCE – located at any low overhead conditions/pipes/obstructions.
 6. WARNING-BIOHAZARD – located within Sludge Dewatering and Sludge Pump Building
 7. DANGER – HIGH VOLTAGE – at each location as required for equipment specified in Division 16.
 8. WARNING – EYE AND EAR PROTECTION – within Sludge Dewatering Building and Sludge Pump Building.
- C. Interior and Directional Signs: Signs shall be ASI/2 type A, constructed of 0.015-inch vinyl laminated to 1/4-inch acrylic backing. Letters shall ASI/2 pressure-sensitive vinyl letters. Signs shall have 1-inch border around perimeter.
1. Emergency Shower, Eye Bath: Mounted to each station (Green background, white letters 9" x 20").
 2. Room Names – adjacent to each room in the Sludge Dewatering Building.
- D. Exterior Signs:
1. Products and Manufacturers: Provide one of the following:
 - a. Graphic Blast Wall Mounted Signs, by Best Manufacturing Sign Systems, Inc.
 - b. Blast Etched Fiberglass Exterior Signs by Visigraph Corporation
 - c. Or equal
 2. Material: Provide surface-etched lettering and pictograms, sandblasted on an opaque three-ply laminate of 1/4-inch thick flat three-ply glass-reinforced resin sheet with non-glare surface and contrasting color core suitable for continuous operating temperatures of 190 degrees F.
 3. Alphabet and Graphics: Provide four-inch high Helvetica Medium alphabet; upper case letters and matching arrow type face.
 4. Provide opaque black letters on opaque white background with concealed, flush-mounted fasteners at each corner. Provide one sign for each building or structure name and one sign for each building or structure number. Sign size shall to be determined based on length of building/structure name and in no case shall

sign be less than 15 inches by 15 inches with 1/8-inch radiused corners.

5. Building Names – Electrical Building.
6. Tank Names - Sludge Thickener Tank No. 1, Sludge Thickener Tank No. 2.
7. Building Numbers – Building No. 85 for Sludge Pump Building and Building No. 88 for Sludge Dewatering Building.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Locate sign units and accessories where shown or directed, using mounting methods of the type described and in compliance with the manufacturer's instructions.
- B. Install signs level, plumb and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

3.2 CLEANING AND PROTECTION:

At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Engineer.

END OF SECTION

SECTION 11000

GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE:

- A. General: This section specifies general requirements which are applicable to all mechanical equipment. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of the individual equipment specification section.
- B. Equipment Lists: Equipment lists, presented in these specifications and as specified on the Drawings, are included for the convenience of the City's Engineer and Contractor and are not complete listings of all equipment, devices and material to be provided under this contract. The Contractor agrees to prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.2 QUALITY ASSURANCE

- A. Arrangement: The arrangement of equipment shown on the Drawings is based upon information available to the City at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. The contractor shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations.
- B. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ABMA Std 9-90	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11-90	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1 89	Unified Screw Threads
ANSI B1.20.1 83	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125 and 250)
ANSI B16.1 89	Cast Iron Pipe Flanges and Flanged Fittings, Class 125
ANSI B18.2.1 81	Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Log Screws
ANSI B18.2.2 87	Square and Hex Nuts
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

- C. Unit Responsibility: The unit responsibility for equipment systems made up of two or more components shall be provided in accordance with Section 01600.
- D. The Contractor shall assure that all equipment systems provided for the project are products for which unit responsibility has been accepted by the responsible manufacturer. Where the detailed specification requires the Contractor to furnish a certificate from the Unit Responsibility Manufacturer, such certificates shall conform to the content, form and style of Form 11000-C specified in Section 01600, shall be signed by an officer of the manufacturer's corporation and shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the work.
- E. Balance: Unless specified otherwise, all rotating elements in motors, pumps, centrifuge and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

$$e = \frac{W}{16N}$$

WHERE:

E = IMBALANCE, OUNCE-INCHES, MAXIMUM

W = WEIGHT OF THE BALANCED ASSEMBLY, POUNDS MASS

N = MAXIMUM OPERATIONAL SPEED, RPM

WHERE SPECIFIED, BALANCING REPORTS, DEMONSTRATING COMPLIANCE WITH THIS REQUIREMENT, SHALL BE SUBMITTED AS PRODUCT DATA.

PART 2 - PRODUCTS

2.1 FLANGES AND PIPE THREADS

- A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.
- B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.
- C. Flange assembly bolts shall be heavy pattern, hexagonal head, stainless steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.2 BEARINGS

- A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum B 10 rating life of 100,000 hours. The rating life shall be determined using the maximum equipment operating speed.
- B. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain

and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

- C. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gage.
- D. All bearings accessible to touch and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or appropriate shielding shall be provided that will prevent inadvertent human contact.

2.3 PUMP SHAFT SEALS

- A. General: Seals for water and wastewater pump shafts shall be either stuffing box or mechanical seals. Unless specified otherwise, stuffing boxes and mechanical seals shall conform to the requirements set forth in this paragraph.
- B. Mechanical Seals: Unless otherwise specified, the following shall be adhered to. Where mechanical seals are specified, the seal shall be of a nondestructive (nonfretting) type which requires no wearing sleeve for the shaft. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area. Mechanical seals shall be the cartridge type, requiring no field assembly, other than insertion into the pump. Metal parts shall be Type 316 or 316L stainless steel. Springs shall be Hastelloy C. Rotary faces shall be tungsten carbide or silicon carbide. Stationary faces shall be ceramic, tungsten carbide, or silicon carbide.
- C. Unless otherwise specified, mechanical seals for overhung shaft, constant speed pumps and split case, centrifugal pumps shall be self-aligning, single, rotary type, Chesterton 155, Crane 88 S, or equal.
- D. Unless otherwise specified, mechanical seals for variable speed, overhung shaft pumps shall be double, balanced, self-aligning type, Crane 88 D, Chesterton 222 or 255, or equal.
- E. Boxes for mechanical seals on pumps for contaminated water service (sludge, grit, wastewater, scum, reclaimed water, etc.) shall be drilled and tapped for installation of clean water barrier fluid supply piping.

- F. Seals for all vertical pumps (whether column or volute type) shall be provided with a second flush connection. Vertical pumps shall have a vent valve attached to the mechanical seal to eliminate air from the seal chamber prior to pump start; start-up procedures shall include venting instructions; and for remotely started pumps, the vent system shall be automated. Where specified in the detailed specifications, permissive confirmation automatic vent systems shall be provided.
- G. Shaft Packing: Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal specified in paragraph 11000-2.04.B for the applicable pump and operating conditions.
- H. Unless otherwise specified, lantern rings shall be bronze or teflon, packing shall be die molded packing rings of nonasbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC-20. Threaded lantern ring removal tools shall be provided with spare parts for each pump. The impeller end of the packing on all but line shaft pumps with external source water lubricated bearings shall be fitted with a SpiralTrac, Version P packing protection system as manufactured by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.
- I. Unless otherwise specified, the section of each shaft or impeller hub that extends through or into the stuffing box shall be fitted with a replaceable stainless steel sleeve with a Brinell hardness of not less than 500. The sleeve shall be held to the shaft to prevent rotation and shall be gasketed to prevent leakage between the shaft and the sleeve. Minimum shaft sleeve thickness shall be 3/8 inch.

2.4 COUPLINGS

- A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taperlock bushings which shall give the equivalent of a shrunk on fit. There shall be no metal to-metal contact

between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

- B. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.5 GUARDS:

Exposed moving parts shall be provided with guards which meet the requirements of OSHA. Guards shall be fabricated of 14 gage stainless steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard, unless otherwise specified. Guards shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.6 CAUTION SIGNS

Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION – AUTOMATIC EQUIPMENT MAY START AT ANY TIME". Signs shall be constructed of fiberglass material, minimum 1/8 inch thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the Drawings. Signs shall be installed near guarded moving parts.

2.7 GAGE TAPS, TEST PLUGS AND GAGES

Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Divisions 13 and 15, respectively.

2.8 NAMEPLATES

Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible location with stainless steel screws or drive pins.

2.9 LUBRICANTS

The Contractor shall provide for each item of mechanical equipment a supply of the lubricant required for the commissioning period. Lubricants shall be of the

type recommended by the equipment manufacturer and shall be products of the City's current lubricant supplier. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the Contractor shall provide the City with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.10 ANCHOR BOLTS

Anchor bolts shall be designed for lateral forces for both pullout and shear in accordance with the table below. Unless otherwise stated in the detailed specification, anchor bolt materials shall be 316 stainless steel.

SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS ¹

Bolt Diameter (inch)	F1554 Grade 36				F1554			
	F593 Type 316, Condition A				Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ^{3,4} (lb)	Tension ³ (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ (lb)	Tension ³ (lb)
1/2	6	9	1,262	2,420	8.5	12.75	1,660	3,190
5/8	7.5	11.25	2,010	3,860	10.5	15.75	2,640	5,080
3/4	9	13.5	2,974	5,720	13	19.5	3,910	7,520
7/8	10.5	15.75	4,106	7,890	15	22.5	5,400	10,390
1	12	18	5,386	10,360	17	25.5	7,090	13,450
1 1/8	13.5	20.25	6,787	13,052	19	28.5	8,930	16,580
1 1/4	15	22.5	8,617	16,572	21	31.5	11,340	20,040

2.11 SPARE PARTS

Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

PART 3 - EXECUTION

Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

+++ END OF SECTION +++

SECTION 11002

RIGID EQUIPMENT MOUNTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies minimum requirements for rigid equipment mounts (baseplates, soleplates, and mounting blocks) and their installation on equipment pads. Completed equipment supports shall consist of equipment pads, equipment anchors, and rigid equipment mounts (baseplates, soleplates, or mounting blocks) set in grout.
2. Unless alternate requirements for equipment mounts are specified in the applicable equipment specification, the requirements of this section shall be applied to rigid mounts for all rotating or reciprocating equipment that is used to mix, convey, or pressurize fluids (gases and liquids). The requirements of this section shall also apply whenever referenced in specifications for other types of equipment. If conflict exists between this section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.

B. Definitions: Specific equipment mounting terminology used in this section conforms to the following definitions:

1. Baseplate: Fabricated (welded structural steel elements), cast, or plate steel base providing a common mounting element on which the legs, feet, or mounting surfaces of equipment are mounted by means of bolted connections.
2. Soleplate: A machined plate, spanning an opening in the floor or equipment pad, providing a common mounting element on which the legs, feet, or mounting surfaces of equipment are mounted by means of bolted connections.
3. Mounting Blocks: Multiple smaller baseplates on which individual legs, feet or equipment supports are mounted when equipment or drivers are not fastened to a common baseplate or sole plate.
4. Equipment Pad: Concrete foundation (block or slab) supporting and elevating equipment mounts above the supporting structural floor slab or local grade.
5. Mounting Pads: Thickened or raised areas of baseplates and soleplates where the feet or mounting surfaces of mounted equipment and drivers are bolted and/or doweled to the baseplate or soleplate.
6. Leveling Blocks: Temporary steel blocks placed under baseplates, soleplates, or a mounting block at leveling positions (at equipment

- anchors) for the purpose of leveling baseplates, soleplates, or mounting blocks prior to grouting.
7. Shims: Thin stainless steel plates of a uniform thickness installed on top of Leveling Blocks for fine adjustment of level. Shims may also be used between equipment or drivers and baseplates, soleplates, or mounting blocks for equipment alignment purposes.
 8. Wedges: Pairs of uniformly tapered metal blocks that are stacked with the tapered surfaces reversed (relative to the other wedge) so that the top and bottom surfaces of the wedges are parallel. Wedges are used between equipment pads and baseplates, soleplates, or mounting blocks for the purpose of leveling baseplates, soleplates, or mounting blocks.
 9. Mounting Stud: Threaded rod or bolts anchored to baseplates, soleplates, or mounting blocks for the purpose of mounting equipment or ancillary devices onto baseplates, soleplates, or mounting blocks.
 10. Reinforcement Dowels: Steel reinforcement rods embedded in concrete, across a cold joint, for the purpose of transferring loads or force across the joint.
 11. Machine Alignment Dowels: Tapered diameter rods inserted in tapered diameter holes for the purpose of aligning machinery. The practice of drilling tapered diameter holes through machinery and baseplates so that Machine Alignment Dowels may be inserted to facilitate alignment of machinery is known as Doweling.
 12. Leveling Position: A location on the top of a concrete equipment pad where leveling tools and equipment will be temporarily installed or used for the purpose of leveling baseplates, soleplates, and mounting blocks prior to grouting.
 13. Grout Manufacturer: Refers to the manufacturer of the epoxy grout system used for installation of rigid equipment mounts.
 14. Grout Manufacturer's Technical Representative(s): Refers to the technical representative(s) of the Grout Manufacturer.

- C. Equipment Mounting Requirements: Unless otherwise specified, equipment and drivers shall be rigidly mounted on a common cast iron or fabricated steel baseplate or soleplate grouted into place on a concrete equipment pad. Under no circumstances shall baseplates, soleplates, or mounting blocks be grouted directly to concrete slabs or floors. Equipment that uses an interdependent equipment and driver mounting configuration (equipment that is bolted onto the driver frame and equipment that supports the driver entirely from the equipment frame) may be bolted directly on concrete or grout surfaces of equipment pads if the driver is less than five horsepower. Bolting equipment directly on concrete or grout surfaces of equipment pads is not acceptable for equipment and drivers that do not have an interdependent equipment and driver mounting configuration.

1.2 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed document, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/HI 1.4	Centrifugal Pumps – Installation, Operation and Maintenance
ANSI/HI 2.4	Vertical Pumps – Installation, Operation and Maintenance
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
MIL-PRF-907E	Anti-Seize Thread Compound, High Temperature
SSPC	Society for Protective Coatings Specifications, Vol. 2
IBC	2001 International Building Code (including local amendments)

B. Quality Control by Contractor:

1. To demonstrate conformance with the specified requirements for rigid equipment mounts, the Contractor shall provide the services of an independent testing laboratory that complies with the requirements of ASTM E329. The testing laboratory shall sample and test equipment mount related materials as indicated in this Section. Costs of testing laboratory services shall be borne by the Contractor.
2. For equipment with drivers 20 horsepower and greater, the Contractor shall furnish the services of a grout manufacturer's technical representative that has been factory trained by the grout manufacturer. The grout manufacturer's technical representative shall perform training and quality control of epoxy grout installation for rigid equipment mounts as indicated in this section.

1.3 SUBMITTALS

The following information shall be provided in accordance with the submittal requirements specified in the General Conditions.

- A. A copy of this specification section, with addendum updates included, (referenced sections need not be included for Section 11002) with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. Copies of this specification section shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.
- B. Schedule of rigid equipment mount installations specified in paragraph 11002-2.1.

- C. Name, employer and certificates or other information documenting compliance with the journeyman qualifications requirements for millwrights who will install rigid equipment mounts, as specified in paragraph 11002-3.3. C.
- D. Certificates or other documentation issued by the epoxy grout manufacturer that demonstrates that the grout manufacturer's technical representative has been factory trained on installation of epoxy grout for equipment mounts, as specified in paragraph 11002-1.2 B. 2.
- E. Shop drawings for all equipment pads, equipment anchors, and baseplate, soleplate or mounting block details. Shop drawings shall depict size and location of equipment pads and reinforcement; equipment drains; equipment anchor, size, location, and projection; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate; soleplate; or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate, or mounting blocks shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.

PART 2 - PRODUCTS

2.1 GENERAL

Prior to initiating any installation efforts, the Contractor shall produce a rigid equipment mount installation schedule containing the expected dates for installing equipment anchors and preparation of equipment pads for leveling, grouting, and final equipment anchor clamping for each item of equipment. The schedule shall list the equipment, by equipment tag number, and shall list applicable equipment specification section, motor horsepower, and name of the Contractor's representative responsible for quality control during installation of rigid equipment mounts. The schedule shall be accompanied by written verification of equipment anchor clamping torque from the manufacturer of each item of equipment to be installed with rigid equipment mounts.

2.2 CONCRETE EQUIPMENT PADS

- A. Concrete equipment pads shall be as shown in the structural details for equipment pads and equipment anchors for rigid mounted equipment.
- B. The Contractor shall submit equipment anchor calculations for all equipment with drivers 20 horsepower and greater. Equipment anchor calculations shall demonstrate that equipment anchor size, embedment, and edge distance comply with the UBC and local governing code and are sufficient to resist the maximum lateral and vertical forces specified in

paragraph 11000-2.11. Equipment anchor calculations shall be sealed by a registered structural or civil engineer licensed in the State of Georgia.

2.3 BASEPLATES, SOLEPLATES, AND MOUNTING BLOCKS

A. General:

1. Unless otherwise specified, Type I baseplates, soleplates, and mounting blocks shall be a minimum of 1 inch thick for equipment with drivers 20 horsepower and larger.
2. Type I baseplates, soleplates, and mounting blocks shall have edges of surfaces bearing on grout rounded to a radius of not less than 0.25 inch. Horizontal corners of Type I baseplates, soleplates, or mounting blocks shall be rounded to a radius of not less than two inches to avoid producing stress risers on the grouted foundation. Grout pouring holes (minimum 4 inches in diameter for epoxy grout, minimum 2 ½ inches in diameter for cementitious nonshrink grout) shall be provided in all baseplates and soleplates and all baseplates and soleplates shall have grout release holes. Mounting blocks may be grouted without grout pouring holes provided that no dimension of the mounting block (width or length) exceeds 18 inches. Grout relief or vent holes (minimum 1 inch in diameter) shall be provided in all baseplates, soleplates, and mounting blocks. Internal stiffeners shall be provided on all cast and fabricated baseplates and shall be designed to allow free flow of grout from one section of the baseplate to another. The minimum acceptable opening in cross bracing and stiffeners shall be 2 inches high by 6 inches in width. All welds shall be continuous and free from skips, blowholes, laps and pockets.
3. Mounting holes for equipment anchors shall be drilled through baseplates, soleplates, and mounting blocks. Mounting holes for equipment anchors shall not be burned out and they shall not be open slots. Unless otherwise specified, mounting studs shall be Type 316 stainless steel or as recommended by the equipment manufacturer for the specific service. An anti-seize or anti-galling compound, as specified in paragraph 11002-2.06, shall be applied to all mounting stud threads prior to installing nuts on mounting studs. Terminations requiring connections to baseplates, soleplates, or mounting blocks shall be acorn nuts welded to the under side of the baseplate or nuts welded to the underside of the baseplate and plugged with cork, plastic plugs or grease. In no case shall the fastener terminate only into the metal base. Where baseplates, soleplates, or mounting blocks are leveled using jackscrews, jackscrew threads shall be tapped in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.
4. Mounting pads for equipment shall be machined after all welding and stress relieving and shall be coplanar within 0.002 inch per foot in all directions. Mounting pads shall extend not less than 0.5

inch beyond the perimeter of the foot or mounting surface of the mounted equipment, in any direction.

5. Equipment baseplates shall provide common support for the equipment and driver (and flywheel, if one is specified). Baseplates for equipment with drivers 20 horsepower and greater shall be furnished with eight transverse alignment (horizontal) positioning jackscrews for alignment of equipment drivers on horizontal surfaces of baseplates. Two of the eight transverse alignment/positioning jackscrews shall be installed in perpendicular directions in a horizontal plane at the mounting position for each corner or foot of the equipment driver. (Eight additional jackscrews shall be provided for transverse alignment of the flywheel, if flywheels are specified.)

- B. Type I Baseplates: Type I baseplates shall be plate or fabricated structural steel baseplates with thickened steel mounting pads for doweling and bolting equipment to the baseplate. The baseplates shall be rectangular in shape for equipment other than centrifugal refrigeration machines and pump baseplates, which may be "T" or "L" shaped to accommodate the equipment drive and accessories. Baseplates for split case pumps shall include supports for suction and discharge elbows, if required by the specified configuration. Perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the baseplate. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
- C. Soleplates: Where soleplates are provided, the underside shall be scribed with the words "THIS SIDE DOWN" using welding rod material prior to milling the mounting pad for each equipment foot or mounting surface. Mounting surfaces and mounting pads on soleplates shall be milled flat to a tolerance of not less than 0.002 inch per foot in all directions. Soleplates shall be machined for an indexed fit to the mounted equipment or driver.
- D. Mounting Blocks: Where equipment is fabricated or cast with feet or mounting surfaces that are not fastened to a common baseplate or soleplate, as in dry-pit bottom suction pumps, the equipment may be supported on individual concrete piers or equipment pads in lieu of a common baseplate or soleplate and equipment pad. In such instances, the equipment shall be supported at the feet or mounting surfaces on individual mounting blocks, which shall be leveled and grouted into place on the individual piers or equipment pads as specified in this section. Vertical volute-type pumps weighing more than 2,000 pounds shall be mounted on mounting blocks under each foot or mounting surface for the pump. All mounting blocks shall be furnished with jackscrew threads (three locations, minimum) tapped in the mounting block for the purpose of leveling mounting blocks with jackscrews.

2.4 GROUT FOR EQUIPMENT PADS

- A. Epoxy Grout for Equipment Mounting: Unless otherwise specified, grout for setting bearing surfaces of baseplates, soleplates, and mounting blocks on equipment pads shall be Epoxy Grout for Equipment Mounting as specified in Section 03055. Where the term epoxy grout is used in the context of details and specifications for equipment mounting it shall mean Epoxy Grout for Equipment Mounting.
- B. Cementitious Nonshrink Grout: Cementitious Nonshrink Grout, specified in Section 03055, may be used for setting bearing surfaces of baseplates, soleplates, or mounting blocks on equipment pads where equipment drivers are 20 horsepower and smaller and the combined weight of equipment and driver is less than 1000 pounds. Where the term nonshrink grout or cementitious grout is used in the context of details and specifications for equipment mounting it shall mean Cementitious Nonshrink Grout. Training and quality control by the grout manufacturer's technical representative is not required for rigid equipment mounts installed with cementitious non-shrink grout.

2.5 EPOXY PRIMER

Epoxy primer shall be a lead-free, chrome-free, rust-inhibitive, two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout. The epoxy primer shall be a product of the epoxy grout manufacturer.

2.6 ANTI-SEIZE/ANTI-GALLING COMPOUND

Anti-seize or anti-galling compound shall be a molybdenum disulfide and graphite combination in an aluminum complex base grease conforming to MIL-PRF-907E. Acceptable products include Jet Lube 550 by Jet Lube, Inc., E-Z Break by LA-CO, or equal.

2.7 PRODUCT DATA

The following information shall be provided in accordance with the product data requirements specified in the General Conditions:

- A. Equipment anchor calculations specified in paragraph 11002-2.2.
- B. Results of grout strength tests, as specified in paragraph 11002-3.3 D.
- C. List of Contractor's equipment installation staff that has completed epoxy grout manufacturer's grout installation training specified in paragraph 11002-3.2 A.

PART 3 - EXECUTION

3.1 GENERAL

- A. Grouting for installation of equipment on equipment pads shall take place prior to connecting any field piping or electrical and instrumentation systems. Unless the Engineer accepts an alternate installation procedure in writing, baseplates, soleplates, and mounting blocks shall be leveled and grouted with the equipment removed. Pumps shall be installed in accordance with this section and ANSI/HI 1.4 or ANSI/HI 2.4, as appropriate for the type of pumping equipment installed.
- B. Connecting piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system without imposing strain on the equipment connections.
- C. Where an equipment manufacturer's installation requirements include a rigid connection between the machine and connecting piping systems, the Contractor shall delete any flexible coupling (including equipment connection fittings) shown on the drawings and install the equipment in the following manner, in lieu of installing the flexible coupling:
 - 1. The equipment pad shall be prepared as shown on the details for rigid equipment mounts
 - 2. The baseplate, soleplate, or mounting blocks supporting the equipment shall be installed, leveled, and grouted in place as specified in this section.
 - 3. The equipment shall be installed, aligned and doweled in place as specified in Section 11005.
 - 4. The piping shall be installed and aligned to the equipment connections and the field piping connections without welding one of the joints for one section of pipe between the equipment connection and the field piping and all valving. All flanged joints shall be bolted up and pressure tested.
 - 5. All piping shall be fully supported by supports designed to accept their full weight and thrust forces.
 - 6. The final sections of piping shall be aligned with the equipment and field connections without the use of jacks, chain falls or other devices to force it into alignment.
 - 7. The final piping joints shall be welded only after the previous steps have been completed and accepted by the Engineer.

3.2 EPOXY GROUT TRAINING AND QUALITY CONTROL

- A. Epoxy Grout Training: Prior to commencing rigid equipment mount installation work on equipment pads, the Contractor shall furnish the services of a grout manufacturer's technical representative to conduct a training school for the workers that will be using the epoxy grout for rigid equipment mount installations. The school shall be not less than 4 hours in length and shall cover all aspects of using the products, from mixing to

application. This requirement, however, shall not be construed as relieving the Contractor of overall responsibility for this portion of the work. The epoxy grout manufacturer shall furnish a list of school attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

B. Epoxy Grout Quality Control:

1. For equipment with drivers 20 horsepower and greater, the epoxy grout manufacturer's technical representative shall provide quality control services for epoxy grout installation in rigid equipment mounts. The epoxy grout manufacturer's technical representative shall be on site to inspect and verify that the application personnel have successfully performed surface preparation, epoxy grout application, and Quality Control Inspection in accordance with these specifications for a representative portion of the epoxy grout installation work.
2. Specifically, the epoxy grout manufacturer's technical representative shall perform the following services for at least one rigid equipment mount installation for each equipment type and size:
 - a. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
 - b. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria, including but not limited to substrate profile, degree of cleanliness, and moisture.
 - c. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
 - d. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
 - e. Inspect preparation and application of epoxy grout form work for conformance to the specifications.
 - f. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during installation.
 - g. Inspect epoxy grout for cure.
 - h. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
 - i. Conduct a final review of completed epoxy grout installation for conformance to these specifications.

3.3 INSTALLATION

A. Concrete Equipment Pad Preparation:

1. After the concrete is fully cured, the top of the equipment pad shall be roughened by chipping the surface. Chipping shall remove all laitance and defective or weak concrete and result in a rough surface profile with a 0.25 inch minimum amplitude. Chipping shall expose broken aggregate without dislodging unbroken aggregate from the cement matrix and shall not cause fractures below the concrete surface. Leveling surfaces of the concrete that have been finished smooth and level for baseplate, soleplate, or mounting block leveling at equipment anchors shall be protected from damage during chipping. A light duty, hand held pneumatic chipper with a chisel type tool shall be used for chipping the equipment pad concrete surface. Abrasive blast, bush-hammer, jackhammers with sharp chisels, heavy chipping tools, or needle gun preparation of concrete surfaces to be grouted is not acceptable.
 2. Prior to leveling activities, satisfactory removal of defective or weak concrete shall be demonstrated in the presence of the Engineer by operating the chipper on the chipped concrete surface at locations identified by the Engineer. The chipped surface of the concrete shall be such that the final baseplate, soleplate, or mounting block elevation results in the grout manufacturer's recommended grout thickness between the surface of the equipment pad and the lower baseplate flange, underside of the soleplate or underside of mounting block.
 3. All dust, dirt, chips, oil, water, and any other contaminants shall be removed and the surface protected with plastic sheeting until grout is installed.
 4. Concrete equipment pad surfaces that have been finished smooth and level for use as leveling positions shall be protected from damage during chipping activities. Alternatively, leveling positions may be restored on chipped surfaces. Leveling positions shall be restored by installing leveling blocks or leveling plates for jackscrews on a high compressive strength epoxy putty (Philadelphia Resins, Phillybond Blue 6A, or equal). Leveling blocks and leveling plates shall be installed level on the epoxy putty.
- B. Baseplates, Soleplates, and Mounting Blocks: All surfaces of baseplates, soleplates, and mounting blocks to be in contact with epoxy grout shall be cleaned to SSPC SP-6 and shall be primed with epoxy primer within 8 hours of cleaning.

C. Leveling:

1. All machinery shall be mounted and leveled by journeyman millwrights. Precision surveying equipment shall be used for leveling. Machinists' spirit levels will not be permitted for leveling purposes for any baseplate, soleplate, or mounting block with a plan dimension greater than 4 feet. Baseplates and mounting blocks shall be leveled to a maximum tolerance of 0.002 inch per foot or as otherwise required by the equipment manufacturer, if more stringent. Soleplates shall be leveled to 0.0005 inch per foot or as otherwise required by the equipment manufacturer, if more stringent. An anti-seize or anti-galling compound specified in paragraph 11002-2.6 shall be applied to all equipment anchor threads prior to beginning baseplate, soleplate, or mounting block leveling.
2. All baseplates, soleplates, and mounting blocks shall be leveled against steel surfaces (jackscrew plates, leveling blocks, leveling nuts, support plates, or other steel surfaces). Use of other materials for leveling purposes is strictly and specifically prohibited. Unless otherwise specified, baseplates, mounting blocks, and soleplates shall be leveled as indicated in the leveling details. Leveling equipment and tools shall be stainless steel leveling blocks and shims, steel wedges, or jackscrews bearing on leveling plates. Leveling nuts may be used for leveling baseplates and soleplates weighing less than 200 pounds. The use of leveling nuts for leveling mounting blocks is not permitted.
3. After baseplates, soleplates, or mounting blocks have been leveled on the leveling equipment, the Contractor shall clamp the baseplates, soleplates, or mounting blocks in position by installing the equipment anchor nuts and washers. Clamping torque shall be less than the final clamping torque specified in paragraph 11002-2.1, but sufficient to hold the baseplate, soleplate, or mounting block in position. The Contractor shall verify that the correct level and position of the baseplate, soleplate, or mounting block has been maintained after clamping on the leveling equipment.
4. Leveling blocks shall be stainless steel, four inches square and 1-1/2 inches thick with an open-ended slot terminating in the center for the equipment anchor. Leveling blocks shall be machined flat on all horizontal surfaces and placed under the baseplate or soleplate at each equipment anchor. Shims shall be pre-cut stainless steel, slotted for removal after grouting, and shall extend not less than three inches beyond the baseplate, soleplate or mounting block. Leveling blocks and shims shall be coated with a light oil just prior to beginning the leveling and grouting work. Shims shall be placed so the tabs on the shims are easily accessible.

D. Grouting:

1. Grout forms shall be built of minimum 0.75 inch thick waterproof plywood and shall be securely braced (minimum brace size shall be two-by-four lumber). Forms shall be designed for a minimum of 6 inches hydrostatic head above the final elevation of the grout, to assist in flow during installation. Equipment mounting grout shall be furnished with expansion joints installed at four to six foot intervals, perpendicular to the centerline of baseplates.
2. Forms shall be coated with three coats of paste wax on all areas that will come in contact with the grout to prevent the grout from bonding to the forms. Forms shall be waxed before assembly to prevent accidental application of wax to surfaces where the grout is to bond. Before any forms are installed, all concrete surfaces that will contact epoxy grout shall be free from any foreign material, such as oil, sand, water, wax, grease, etc. Forms shall be liquid tight. Any open spaces or cracks in forms, or at the joint between forms and the foundation, shall be sealed off, using sealant, putty, or caulking compound. All outside vertical and horizontal edges of the grout shall have 45-degree chamfers as indicated in the equipment anchor details for rigid equipment mounts. Match chamfers in concrete portions of the equipment pad. Block outs shall be provided at all shimming and leveling positions to allow removal of leveling equipment and tools after the grout has cured. Jackscrews shall be coated with a light oil or other acceptable bond-breaking compound prior to grouting.
3. The 45-degree perimeter chamfer strip shall be located at the final elevation of the grout. The final elevation of the grout on baseplates with exposed I-beam or C-channel supports shall be at the top of the lower support flange. The top of the grout, on all other baseplates soleplates, and mounting blocks, shall be at least 1.0 inch above the bottom or underside of the baseplate, soleplate, or mounting block and shall not be higher than the top of the baseplate, soleplate, or mounting block. The grout's final elevation shall not be so high as to bond the equipment anchor nut and washer.
4. The resin and hardener for epoxy grout for equipment mounting shall be mixed in accordance with the epoxy grout manufacturer's recommendations. Epoxy grout shall be placed at the center of one end of the baseplate or soleplate and worked toward the ends in such a manner as to force the air out from beneath the baseplate or soleplate and out the vent holes, to eliminate voids. Epoxy grout shall be placed in a manner that avoids air entrapment, using a head box to pour grout into the grout holes. When the head box is moved to the next grout hole, a 6 inch high standpipe shall be placed over the grout hole and filled with grout. Use of vibrating tools and/or jarring (rapping or tapping) forms to facilitate grout flow is not permitted during placement of epoxy grout.

5. The Contractor shall exercise care to never allow the grout to fall below the baseplate level once the grout has made contact with the baseplate. Grout placement shall be continuous until all portions of the space beneath the baseplate, soleplate, or mounting block have been filled. Subsequent batches of grout shall be prepared so as to be ready when the preceding batch has been placed. Under no circumstances shall the grouting operation be halted because of lack of grout mix. After the entire baseplate is full, 6 inch high standpipes shall be maintained over each grout hole, to continue purging of air. When the grout has started to take an initial set (typically this is determined by a noticeable increase in temperature and no flow of grout at the vent holes) the standpipes shall be removed and excess grout cleaned from all surfaces.
6. Where the cavity under a baseplate or mounting block extends above the elevation of the top of the bolting flange for the baseplate or mounting block, grouting may be completed in two pours. Under these circumstances, the first grout pour shall be continuous until the lower face of the bolting flange for the baseplate or mounting block is submerged in grout a minimum of one inch. The second grout pour shall be completed with standpipes and air purges as specified in the previous paragraph.
7. Grout forms shall be checked for leaks throughout grout pours. Leaks shall be repaired immediately to prevent formation of voids. A final check of baseplate, soleplate, or mounting block level and elevation shall be performed before the grout sets.
8. A grout sample shall be taken for each equipment pad that has a baseplate, soleplate, or mounting block set in grout. The sample shall be placed in a cylinder of sufficient size to yield three two-inch cubes as test samples. The samples shall be tagged with project name, date, time, the equipment number and ambient temperature at the time of placement. Once the epoxy grout cylinder has been completely filled, it shall be placed next to the foundation of the equipment being grouted and allowed to cure for 48 hours. After 48 hours, the test cylinder shall be tested in accordance with the grout manufacturer's recommendations by the independent testing laboratory specified in paragraph 11002-1.2 B. The results shall be reported directly to the Engineer. Forms shall be removed only after the grout has cured sufficiently and upon specific permission from the Engineer.

E. Completion:

1. Upon acceptance by the Engineer and the equipment manufacturer's representative and after the grout has reached sufficient strength, grout forms and block outs at leveling positions shall be removed. Leveling blocks and shims or wedges and support plates shall be removed, leveling nuts and jack screws shall be backed off to allow the grout to fully support the

baseplate, mounting block, or soleplate. Take care not to damage the grout during removal of extended shimming material or leveling equipment and tools.

2. The equipment anchor nuts shall be tightened, using calibrated indicating torque wrenches, to develop the full clamping force required by the equipment manufacturer.
3. Equipment anchor nuts shall be tightened in increments of not more than 25 percent of the final torque value in an alternating pattern to avoid stress concentration on the grout surface. After tightening equipment anchor nuts to final values, apply additional wax, grease, or mastic to all exposed portions of the equipment anchor beneath the baseplate, soleplate, or mounting block.
4. After applying additional wax or mastic to exposed portions of equipment anchors, block outs (pockets) for access to leveling nuts, leveling blocks and shims, or wedges shall be filled with the grout material installed under baseplates, soleplates, or mounting blocks and pointed after the equipment anchor nuts have been tightened to final values. Jackscrews shall be removed and holes in the baseplate, soleplate, or mounting blocks filled with a flexible sealant (silicone rubber) or a short cap screw.
5. Check for baseplate, soleplate, or mounting block movement (soft foot) by individually loosening and re-tightening each equipment anchor. Vertical movement at each equipment anchor shall be measured and recorded during loosening and retightening and shall not exceed 20 micrometers (0.001 inch). Vertical movement shall be measured using a magnetic-based dial indicator on the baseplate, soleplate, or mounting block referenced to the epoxy grout surface of the equipment pad or other approved method. Soft foot conditions shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or mounting blocks.
6. Check for grout voids by tapping along the upper surfaces of the baseplate, soleplate, or mounting block. Grout voids shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or mounting blocks. Grout voids shall be marked. At the discretion of the Engineer, grout voids may be repaired as specified in Chapter 5, Section 3.16 of API 686.

3.4 FINAL INSPECTION

The Engineer will conduct a final inspection with the Contractor for conformance to requirements of the contract documents.

+++ END OF SECTION +++

SECTION 11113

CHAIN-AND-RAKE BAR SCREENS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install chain-and-rake bar screens complete and operational.
 - 2. Included are screen, control panel, anchorage systems and all appurtenances.
- B. Coordination: Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the chain-and-rake bar screens Work.
- C. Related Sections:
 - 1. Section 03055, Concrete.
 - 2. Section 05051, Anchor Systems.
 - 3. Section 09900, Painting.
 - 4. Section 14620, Screw Bulk Conveyor
- D. Standards referenced in this Section are listed below:
 - 1. American Bearing Manufacturers Association, (ABMA).
 - 2. American National Standards Institute, (ANSI).
 - 3. American Society of Mechanical Engineers, (ASME).
 - 4. American Society for Testing and Materials, (ASTM).
 - 5. Institute of Electrical and Electronics Engineers, (IEEE).
 - 6. National Electrical Code, (NEC).
 - 7. National Electrical Manufacturers' Association, (NEMA).
 - 8. National Fire Protection Association, (NFPA).
 - 9. Underwriters' Laboratories, Incorporated, (UL).

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of the component manufacturer from a single chain-and-rake bar screens manufacturer.
 2. The chain-and-rake bar screens equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the chain-and-rake bar screens equipment manufacturer.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Product Data:
 - a. Manufacturer's literature, data sheets, fabrication, assembly and mounting drawings of the following components showing materials and significant dimensions in sufficient detail to demonstrate compliance with specified requirements.
 - 1) Screen Mechanism:
 - a) Sizes of structural members.
 - b) Rack details.
 - c) Cleaning rake details.
 - d) Seal plate.
 - e) Screen housing.
 - 2) Gear Reducer:
 - a) Model number.
 - b) AGMA horsepower rating.
 - c) Materials of construction.
 - d) Efficiency.
 - e) Bearing ratings.
 - f) Lubrication details.
 - g) Bearing life under maximum loading conditions.
 - 3) Motor:
 - a) Horsepower.
 - b) Rpm.
 - c) Insulation and enclosure details.
 - d) Efficiency at full, 3/4 and 1/2 load.
 2. Shop Drawings:

- a. Wiring diagrams showing all electrical connections to the motor and variable speed drive control.
 - b. Drawings of control panels furnished in accordance with Division 17.
 - c. For all components of equipment as appropriate, provide setting drawings and instructions for installation of anchor bolts, including tolerances.
- B. Information Submittals: Submit the following:
 - 1. Support Design Information:
 - a. Weight of the complete assembly.
 - 2. Source Quality Control Submittals:
 - a. Submit results of performance test of gear reducer.
 - b. Submit results of required control panel shop tests.
 - 3. Site Quality Control:
 - a. Submit a written report giving the results of required field tests.
 - b. Submit written report of results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed and results obtained.
- C. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Manuals:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Division 01
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. Furnish all required spare parts as specified in Part 2 of this specification.
 - 2. Tools:
 - a. Furnish all required special tools as specified in Part 2 of this specification.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Packing:
 - a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
 - b. Protect machined surfaces and mating connections.
 - c. Protect bearings and gearing with a shop applied corrosion prevention coating.

- d. Cover all openings into gear boxes with vapor inhibiting and water repellent material.
 - e. Crate in a manner which will prevent damage during shipment, delivery and storage.
 - f. Identify crate contents by a packing slip fastened to the outside of the crate.
 - 2. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Description:
 - 1. Equipment shall be designed to be suitable for the process and service conditions described below and in the Schedule of Service Conditions.

B. Schedule of Service Conditions:

	Site Data
Parameter	Condition
Waste Fluid Type	Domestic Wastewater
Channel Width, ft.:	3' - 0"
Amount of vertical screen recessing	None
Channel Floor Elevation:	953.34
Operating Floor Elevation:	960
Maximum Flow/Screen, mgd:	19
Average Flow/Screen, mgd:	1.4
Maximum Water Depth in Channel upstream of Screen, ft.:	4.0
Downstream Water Level at Max Flow, ft.:	1.9

Downstream Water Level at Average Flow, ft.:	0.52
Bar Spacing, in.:	0.25
% Screen panel blinding	30%
*Head drop at % blinding, in.:	14.16 (Minimum)
*Head drop at % blinding calculated at Max flow	

Design Data	
Parameter	Condition
Number of Screens, each:	2
Screen Incline, degrees:	60
Bar rack bar size (Minimum)	5/16" x 1/4" x 1-1/2"
Bar rack bar profile	Tapered
Bar spacing (spacing width)	1/4 inches
Wiper blade material	UHMW Polyethylene
Screen Side frame plate thickness	.135 inch (10 GA.)
General construction material	304 SST
Discharge height (above operating floor)	60.00 inches
Rake speed	As Required by Manufacturer
Roller chain pitch range	4.92inch - 6 inch
Roller chain side plate material	316 SST
Roller chain roller, pin, bushing material	17-4 SST
Roller chain ultimate strength (per chain)	16,000 lb _f
Screen drive reducer type	Helical Bevel
Screen drive reducer ratio	Per Manufacturer
Screen motor power	Maximum of 3 Hp
Screen motor rating	XPFC
Screen motor	460V/3Ph.60 Hz

2.2 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
1. JWC Environmental
 2. Headworks International
 3. Huber Technology, Inc.

2.3 DETAILS OF CONSTRUCTION

A. General:

1. Screen shall be mechanically cleaned with the rakes entering the bar rack on the upstream side and ascending to point of discharge.
2. Screen shall consist of a bar rack, side frames, cleaning rakes, dead plate, chains, sprockets, shafting and bearings. Rake cleaning device, hinged seal plate, head section, drive unit, and controls.
3. The screen shall be driven by a motor and speed reducer through a chain and sprocket drive and shall operate at a speed provided in the design data above.
4. Height of the screenings discharge above the operating floor shall be such as to enable the screenings to drop directly into a screw conveyor via a stainless steel chute supplied by screen manufacturer.
5. Screens shall be designed as an integral unit utilizing heavy rigid structural steel side frames into which are tied the rack supports, dead plate and submerged screen section, resulting in a structural self-supporting unit.

B. Bar Rack:

1. Bar rack shall consist of stainless steel bars, dimensions are specified in the table above, formed straight and true, and each bar rack shall be removable from the bar rack assembly. Bars shall not be welded in place.
2. Bar rack shall extend from the bottom of the channel to a height 12-inches below the top of the channel and be connected at that point to a dead plate. Construct the bar rack so that it is removable.
3. Design bar rack to withstand load when the bars are 50 percent clogged by debris.

C. Side Frames:

1. Fabricate side frames of not less than 3/16-inch thick steel and shall include U-shaped guides for both the carrying and return run of the screen chains.
2. Each side frame shall be designed to house the replaceable stainless steel and UHMW polyethylene tracking system.
3. The bottom tracking system shall consist of stainless steel inner and outer rings

D. Cleaning Rakes:

1. Cleaning rakes shall be cup or flat type for cleaning the front and side of the bars.
2. Cleaning rakes shall be evenly spaced apart, mounted on two strands of chain running over sprocket wheels at the ends of the screen. Screenings shall be removed from the bar rack by the rakes, conveyed over the dead plate, and deposited through a chute into a screw conveyor. Bucket type rake shall remove any grit and debris

accumulation from the footshaft recess, convey it over the dead plate, and deposit it through the chute with the screenings.

3. Flat type rakes shall be of 316 stainless steel.

E. Dead Plate:

1. A dead plate shall extend from the end of the bar rack to the discharge point within the head section to prevent screenings from dropping behind the rack. Dead plate shall also prevent screenings from falling back into the flow.
2. Dead plate shall be constructed of not less than 3/16-inch thick stainless steel bolted to the side frames of the screen. It shall be supported by the headshaft and be adjustable to provide movement when the take-ups are adjusted.

F. Discharge Chute:

1. Discharge chute shall convey screenings from the deadplate to the intake flange of the screw conveyor.
2. Chute shall be constructed of not less than 1/8" thick 304 stainless steel. Chute shall be connected to both screen and screenings conveyor by bolted flange connections not less than 2" wide. EPDM 1/8" gaskets are required at flange connections.

G. Chains, Sprockets, and Shafts:

1. Chains:
 - a. Screen chains shall be of cast heavy type or combination type of cast block links and steel side bars.
 - 1) Chain links shall be 316 stainless steel.
 - 2) Fully guard chains with stainless steel guides supported on both runs on each side by grease lubricated take-up bearing assemblies.
 - 3) Rakes and buckets shall be suitably fastened to attachment links on the chain.
 - 4) The chain shall track in a stainless steel guide system mounted in each side frame. Guide systems that incorporate UHMW wear strips are acceptable.
 - b. Shafting and Bearings:
 - 1) All shafting shall be cold finished steel, straight and true, of sufficient size to transmit the power required. Keyways with fitted keys shall be provided where necessary.
 - 2) Headshaft bearings shall be bronze and shall be provided with lubrication fittings brought to the outside of the housing for accessibility.
 - 3) Furnish headshafts with adjustable take-up assemblies.

H. Rake Cleaning Device:

1. Provide screen with an automatic rake wiper. Rake wiper shall provide complete automatic removal of screenings from the rakes. Wiper design shall be such as to prevent screenings from wrapping around rake or wiper. Wiper design shall incorporate shock absorbers to regulate the return of the wiper quietly and without undue shock to the screen.
- I. Head Section:
1. Fully enclose screen housing which extends above the operating floor.
 2. Side plates of the housing shall not be less than 1/4-inch thick steel or polycarbonate. Balance of the housing covering the screen shall not be less than 12-gauge steel with structural supporting members of 1/4-inch minimum thickness. Housing shall be provided with the necessary cleanout and inspection doors on the front and rear of the screen.
- J. Drive Unit:
1. Drive components shall withstand the full NEMA stalling torque of the motor, without damage to any part of the drive.
 2. Drive unit shall consist of a motor driven fully housed helical gear reducer. Gears shall be made of steel with teeth cut to accurate shape and enclosed in a heavy case, moisture and oil proof. Reducer shall be equipped with approved type anti-friction bearings throughout.
 3. Drive unit shall be suitable for a screen travel speed provided in the design criteria table above.
 4. Speed reducer moving parts shall be immersed in oil, and bearings shall be anti-friction throughout, with a minimum B-10 rating of 50,000 hours. Casings shall be provided with inspection covers, oil fill, and drain connections, and means for inspection of oil flow. Inspection, oil fill and drain covers shall be chained to casing.
 5. Motors:
 - a. Totally enclose motor, fan cooled, severe duty, chemical service type, suitable for CLASS 1 DIV 1 Operation.
 - b. Motors shall be suitable for operation on 460 volt, 3 phase, 60 Hz power.
 - c. Adequately size motor so that there is no overload on the motor above rated nameplate horsepower under normal conditions of service, but not less than 1 horsepower.
 - d. Provide space heaters, 120 volt, single phase.
 - e. Motors shall have a 1.15 service factor, and shall comply with the latest ANSI, NEMA, ABMA and IEEE Standards as a minimum.
 - f. Locked rotor current shall be as specified in NEMA standards.

- g. Motors shall be inverter duty if provided with a VFD.
- h. Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of service, and shall have a minimum B-10 life of 100,000 hours.
- i. Motors shall have a stainless steel nameplate which shall provide the following: type, frame, insulation, class, hp, full load current, RPM, centigrade degree rise, manufacturer's name and serial number, model number, voltage, locked rotor KVA code, bearing numbers and a connection diagram.
- j. Motor terminal boxes shall be oversized to provide adequate space for connections and shall be constructed of cast-iron or fabricated steel, neoprene gasketed and bolted. Motor leads shall be permanently marked in agreement with the connection diagram.

K. Overload Protection Device Alternate A:

- 1. Provide overload release clutch on output shaft of the drive assembly.
- 2. Furnish each clutch with a limit switch actuating mechanism and a limit switch. Electrical connections are included under Division 17, Electrical. Limit switches are included under this Section, and shall be equipped with two D.P.D.T. contacts, 10 ampere at 120 volt. Each limit switch actuating mechanism and its associated limit switch shall be housed in a suitable enclosure. Enclosures shall be as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings. Enclosure shall protect the limit switch mechanism from accidental damage but shall still permit easy access for repair and maintenance.
- 3. Clutches shall be of the sealed pressure lubricated grease filled type designed to eliminate corrosion problems due to condensation and corrosive atmospheres. They shall also include a limit stop pin to limit the maximum torque to which a clutch may be adjusted.

L. Overload Protection Device Alternate B:

- 1. Provide torque limiting device on output shaft of drive assembly.
- 2. The torque limiting device shall provide reliable protection against excessive loading. It shall be a ball-detent type which transmits torque through balls retained in detents of two opposing steel plates held against the balls by adjustable spring pressure.
- 3. The design of the torque limiter shall be such that when torque exceeds a pre-set value the balls will leave their seats and roll free between the plates to provide complete disengagement of the driving and driven components. The device shall not incorporate friction plates, and resetting shall be simple, with torque setting

- remaining constant within plus or minus ten percent, after each individual disengagement and resetting.
4. Torque limiter shall be adjustable over a wide range of torques and have provisions to be made tamper-proof to prevent unauthorized adjustments to increased torque setting.
 5. The ball detent plates, as well as any parts where sliding occurs during disengagement, shall be hardened to a minimum of 54 R/C. The torque limiter shall be weather resistant for outdoor applications. The components shall be manganese phosphate treated and oiled, then grease coated and enclosed in a stainless steel sealed cover.
 6. Equip each torque limiter with a limit switch actuating mechanism and a limit switch. Electrical connections are included under Division 16, Electrical. Limit switches are included under this Section, and shall be equipped with two D.P.D.T. contacts, 10 ampere at 120 volt. Each limit switch actuating mechanism and its associated limit switch shall be housed in a suitable enclosure. Enclosures shall be as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings. Enclosure shall be so designed to protect the limit switch mechanism from accidental damage but shall still permit easy access for repair and maintenance.
 7. Manufacturers: Provide Torque Limiting Devices as produced by one of the following:
 - a. Autoguard Series 200, as manufactured by the Autoguard Corporation.
 - b. Or equal.
- M. Overload Protection (if VFD provided):
1. VFD shall have solid state overload protection feature. On meeting a blockage, the device shall be able to automatically reverse the direction of travel of the raking mechanism for an adjustable distance and revert to the forward motion to try to clear the blockage. This reversing action can occur a maximum of three times for any one obstruction. The device shall reset automatically if the blockage causing the initial overload condition is cleared; should the blockage remain upon the completion of the fourth attempt, the screen shall be tripped and an alarm generated. The reverse function shall operate the screen in reverse at the low speed.
- N. Control Panel:
1. General:
 - a. Components:
 - 1) PLC shall be an Allen Bradley model CompactLogix 5069 PLC
 - 2) OIT shall be an QSI model QTERM-A7
 - 3) Circuit Breaker shall be Siemens

- 4) Starters shall be Allen Bradley IEC
 - 5) Relays shall be Allen Bradley and/or IDEC
 - 6) Pilot lights shall be Allen Bradley 22mm Type 4/4X/13
 - 7) Selector switches shall be Allen Bradley Type 4/4X/13
 - 8) Ultrasonic differential level system shall be Endress & Hauser, or equal. Rated for Hazardous Location.
 - 9) Variable frequency drive if required by manufacturer.
- b. Provide a common control panel for both screens and the Screw Bulk Material Conveyor. See section 14620 for conveyor requirements.
 - c. Panel construction shall be NEMA 7 316 Stainless Steel and shall conform to the applicable requirements of Division 17.
 - d. Factory test control panel prior to shipment.
 - e. Furnish a 480 volt, 3 phase, 60 Hz power feeder to the control panel. Include a integral main disconnect, main breaker, step down transformer(s), and circuit breaker load center for all 120 volt panel power requirements.
 - f. The main control panel shall be mounted remotely to the screen and contain the following switches and lights for both bar screens and conveyor:
 - 1) Reset push button
 - 2) Power on light
 - 3) Screen run light
 - 4) Alarm light (overload)
 - g. The local control station shall be rated for hazardous location, mounted locally to the screen and contain the following: **RATED FOR HAZARDOUS LOCATION**
 - 1) Hand/Off/ Auto selector switch for the screen
 - 2) Forward /Off/Reverse selector switch, spring returned in reverse
 - 3) Emergency Stop push button
2. Operation:
- a. When the screen is in the Hand mode and in the Forward position the screen shall run continuously. The Reverse position is spring loaded and shall only operate in the Hand mode.
 - b. In the Auto Mode the screen cycle shall start by a signal from one of the following:
 - 1) Differential level system
 - 2) Timer (backup)
 - 3) Input error from transducer (loss of echo)
 - 4) High level alarm
 - 5) High level start

- c. If the screen starts by differential level the screen shall run until the differential drops below the set point and the off timer times out.
- d. If the screen starts on high level it shall run until the high level drops below the set point and the off timer times out.
- e. If the one of level transducers has an error the screen shall run continuously.
- f. The screen also has a backup timer that shall allow the screen to operate periodically during periods of low activity. The timer is adjustable for both start frequency and duration of run.

2.4 ANCHOR BOLTS

- A. Furnish anchor bolts and nuts of ample size and strength for the purpose intended, sized by the equipment manufacturer. Provide hooked anchor bolts for direct embedment during placement of concrete. Anchor bolt materials shall be of 316 stainless steel and shall comply with the requirements of Section 05051, Anchor Systems.

2.5 TOOLS AND SPARE PARTS

- A. Furnish and deliver the following boxed and labeled.
 - 1. One reducer assembly complete with motor.
 - 2. One driven sprocket.
 - 3. Two complete lengths of screen chain to rebuild one screen.
 - 4. Two sets of any special tools required for normal operation and maintenance.
- B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the Project.
- C. Manufacturer shall furnish a list of additional recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

2.6 SURFACE PREPARATION AND PAINTING

- A. Screening equipment, motors, frames, all ferrous metal surfaces, appurtenances, etc., shall receive shop primer coating conforming to the requirements of Section 09900, Painting.
- B. Surface preparation and painting shall conform to the requirements of Section 09900, Painting.

- C. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.
- D. CONTRACTOR shall certify, in writing, that the shop primer and finish coating system conforms to the requirements of Section 09900, Painting.

2.7 LUBRICANTS

- A. Furnish lubricants and oil and grease as required for initial operation. Use products shall be as recommended by the manufacturer.

2.8 SOURCE QUALITY CONTROL

- A. Running Test: Operate gear reducer at normal operating speed using a rust inhibiting break-in oil prior to shipment to check for proper operation, excessive noise and vibration.
- B. Visual Inspection: Verify that equipment complies with these Specifications and approved Shop Drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall verify that structures, pipes and equipment are compatible.
 - 1. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.
 - 2. Inspect all equipment prior to installation.
 - 3. Promptly report defects which may affect the Work to ENGINEER.
- B. Make adjustments required to place system in proper operating condition.

3.2 INSTALLATION

- A. Manufacturer's representative shall check and approve the installation prior to operation. Manufacturer's representative shall field test and calibrate the equipment to assure that the system operates to the OWNER'S satisfaction.

3.3 FIELD QUALITY CONTROL

- A. All equipment will be given running tests by CONTRACTOR at the job Site following installation of the equipment and controls. Should the tests

indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

- B. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 3 visits, minimum 8 hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- C. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

END OF SECTION

SECTION 11243

INLINE GRINDERS

PART 1 - General

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install a new control panel for two existing inline grinders.
 - 2. Included are the control panel, and all appurtenances.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the inline grinders Work.
- C. Related Sections:
 - 1. Division 17, Instrumentation and Controls for Process Systems

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American Bearing Manufacturers Association, (ABMA).
 - 2. American Gear Manufacturers Association, (AGMA).
 - 3. American Institute of Steel Construction, (AISI).
 - 4. American National Standards Institute, (ANSI).
 - a. ANSI B16.1, Cast-Iron Pipe Flange and Flange Fittings.
 - b. ANSI A21.10, Cast-Iron and Ductile Iron Fittings, 2 Thru 48-Inches.
 - 5. American Society of Testing Materials, (ASTM).
 - a. ASTM A 536, Specification for Ductile Iron Castings.
 - 6. National Electrical Code, (NEC).
 - 7. National Electrical Manufacturers Association, (NEMA).
 - 8. Institute of Electrical and Electronic Engineers, (IEEE).

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section, regardless of the component manufacturer, from a single inline grinder manufacturer.
 - 2. The inline grinder equipment manufacturer to review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the inline grinder equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data:
 - a. Manufacturer's literature, data sheets, fabrication, assembly and mounting drawings of the following components showing materials and significant dimensions in sufficient detail to demonstrate compliance with specified requirements.
 - 1) Electrical Information:
 - a) Wiring diagrams showing all electrical connections to the motor and controls.
- B. Drawings of control panels furnished in accordance with Division 17, Instrumentation and Controls for Process Systems. Informational Submittals: Submit the following:
 - 1. Source Quality Control Submittals:
 - a. Submit results of required control panel shop tests.
 - 2. Site Quality Control Submittals:
 - a. Submit a written report giving the results of the required field tests.
 - b. Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed and results obtained.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Manuals:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Division 01.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:

- a. Furnish all required spare parts as specified in Part 2 of this specification.
- 2. Tools:
 - a. Furnish all required special tools as specified in Part 2 of this specification.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
 - 1. JWC Environmental
 - 2. Or equal.

2.2 DETAILS OF CONSTRUCTION

- A. General:
 - 1. Grinders are to be modular open channel grinders with solids diverter design and function. The Modular system comprised of individual Grinder, Solids Diverter, Tie Frame and Channel Frame allowing replacement of Grinder or Solids Diverter without requirement to replace entire system. Modular adaptability allows Solids Diverter to be replaced with larger or smaller Solids Diverter to increase or decrease flow capacity or Grinder adapted for higher or lower horsepower and torque as demands change throughout the life of the system. System uses rotating perforated screen Solids Diverter to filter water and solids, diverting solids captured on screen to Grinder for solids reduction.

2. Basis of Design:
 - a. Influent Wet Well Grinder (G1.1):
 - 1) Channel Monster Flex model# CMF3636 as manufactured and supplied by JWC Environmental, Inc, or equal.
 - 2) Flow Capacity: 13,194 GPM (19.0 MGD)
 - 3) Cutter Stack and Perforated Drum Height: 36 inches
 - 4) Perforated Drum Diameter: 36 inches
 - 5) Perforated Hole Diameter: ½ inch
 - 6) Solids Diverter Motor Horsepower: 1 HP
 - 7) Grinder Motor Horsepower: 5 HP
 - b. College Park Influent Grinder (G3.1):
 - 1) Channel Monster Flex model# CMF3618 as manufactured and supplied by JWC Environmental, Inc, or equal.
 - 2) Flow Capacity: 3,750 GPM (5.4 MGD)
 - 3) Cutter Stack and Perforated Drum Height: 36 inches
 - 4) Perforated Drum Diameter: 18 inches
 - 5) Perforated Hole Diameter: ½ inch
 - 6) Solids Diverter Motor Horsepower: 1 HP
 - 7) Grinder Motor Horsepower: 5 HP

B. Supports and Installation Frames

1. Design:
 - a. Tie Frame provides structure for mounting and positioning of the grinder and Solids Diverter combining the modules into one system for installation and removal. Channel Frame creates guide slots and baffling to secure Tie Frame, Grinder and Solids Diverter inhibiting bypass of solids or water.
2. Tie Frame and Lifting Brackets/Bail
 - a. Tie Frame
 - 1) Insert tabs slide into Channel Frame slots positioning Grinder and Solids Diverter into channel without further fastening or assembly.
 - 2) Mechanism for adjustment of the grinder to properly set the distance of the cutter teeth to the perforated drum of the Solids Diverter.
 - 3) AISI 304L stainless steel with a passivated bead blast finish.
 - b. Lifting Brackets/Bail
 - 1) AISI 304 stainless steel.
3. Channel Frame/Wall Mount Frame and Guide Rails
 - a. Frame mounts to channel walls (24" College Park Line) and influent wall (42" influent wet well line) with suitable anchors supplied by contractor for installation.

- b. Frame fabricated of AISI 304L stainless steel with a passivated bead blast finish.
- c. Guide Rails fabricated of AISI 304L stainless steel.

C. GRINDER

1. Design:
 - a. Two-shafted with intermeshed individual cutters and spacers supported on both ends of shaft with mechanical seal and bearing cartridges, driven by an electric motor and speed reducer.
 - b. Cantilevered designs are not acceptable.
2. Cutters and Spacers
 - a. Cutters
 - 1) 7-tooth Cam style, .438-inch thick, 4.710-inch diameter, Alloy steel. Designed specifically for waste streams containing heavy volumes of solids.
 - 2) Through hardened to 45-52 HRC.
 - 3) Precision ground individual cutter elements with a thickness tolerance of $+.000/-0.001$
 - 4) Keyed to shaft with hexagon inner profile.
 - b. Spacers
 - 1) Smooth O.D. .446-inch thick, Alloy Steel.
 - 2) Through hardened to 34-52 HRC.
 - 3) Precision ground individual spacer elements with a thickness tolerance of $+.001/-0.000$.
 - 4) Keyed to shaft with hexagon opening.
3. Mechanical Seal and Bearing Cartridges
 - a. Seals and bearing incorporated into a cartridge style design requiring no external seal flush or lubricants to operate wet or dry.
 - b. Rated for over 6X maximum operating depth or 150 psi.
 - c. Secondary lip seal with grease barrier.
 - d. Dynamic and Static seal faces to be Tungsten carbide with 6% nickel binder.
 - e. Cartridge bushing and housing are AISI 304 stainless steel.
 - f. O-rings to be Viton (Fluorocarbon).
4. Shafts
 - a. 2 inch hexagon heat treated AISI 4140 alloy steel.
 - b. Minimum tensile strength of 170,000 psi.
 - c. Compression Nut and Spring Disk
 - 1) Compression Nut
 - a) Stack nut sized to provide proper clamping force to secure cutting stack at manufacturer's recommended torque.
 - 2) Spring Disk

- a) Spring element provides a preload of the cutter stack maintaining a clamping force securing the cutter from movement.
 - a) Disk or seat element prevents overloading of cutter stack by limiting distance spring element can be compressed.
- 5. Housings, Covers and Gaskets
 - a. Housings:
 - 1) Integral bushing deflector directs solids away from Mechanical Seal and Bearing Cartridge bushings.
 - 2) Directional flow arrows on side of housings indicate correct installation orientation in waste stream.
 - 3) Cast ASTM A48 Class 40 gray iron.
 - b. Top Cover:
 - 1) Manufacturing identification plate mounting on surface.
 - 2) Cast ASTM A48 Class 40 gray iron.
 - c. Bottom Cover:
 - 1) ASTM A36 steel plate.
 - d. Gaskets:
 - 1) Cork and neoprene rubber.
- 6. Side Rails
 - a. High Flow Slotted Side Rail
 - 1) Evenly-spaced 3/8 inch horizontal slots and fins.
 - 2) Fin rake angle of 55 to 70 degrees designed to direct solids to the cutters and maximize flow over their surface with a path ratio greater than 1.55 to 1.
 - 3) Clearance between fins and cutters .010 to .015 inches to maximize capture.
 - 4) Cast ASTM A536 65-45-12 ductile iron.
 - b. Screen Side Rail
 - 1) Opening inside rail allows Solids Diverter perforated drum to be positioned close to cutter's tooth tip.
 - 2) Cast ASTM A536 65-45-12 ductile iron.
- 7. Transfer Gears
 - a. Heat treated and hardened AISI 4140 alloy steel.
 - b. Number of teeth on gears creates ratio of cutter tip speed on low speed shaft to cutter tip speed of highspeed shaft greater than 0.90 and less than 1.00 to promote cleanout of processed material in cutting stack.
- 8. Couplings
 - a. Low Speed Coupling
 - 1) Two-piece design with interlocking lobes.
 - 2) Hardened AISI 4140 alloy steel
 - b. High Speed Coupling
 - 1) Type L 3-jaw with elastomer

- 2) Buna-N spider.
9. Lifting Brackets
 - a. AISI 304 stainless steel.
10. Speed Reducer
 - a. Grease lubricated cycloidal design Cyclo Series 6000 with 29:1 reduction ratio.
 - b. Manufacturer: Sumitomo Machinery Corporation of America.
11. Motor
 - a. XPNV Immersible Motor: Baldor Electric Company.
 - 1) Installed Horsepower: 5 HP.
 - 2) Motor Service Factor: 1.15.
 - 3) Minimum Motor Efficiency (at Full Load): 91 percent.
 - 4) Minimum Motor Power Factor (at Full Load): 76.
 - 5) Peak Input Torque with Reducer: 1,665 lb-ft.
 - 6) Peak Force at Cutter Tip: 8,482 lbf.
 - 7) UL rated NEMA 6P, Class I, Div. 1 Groups C&D, Class II Div. 2, Groups F&G, Class III Div. 1.
 - 8) Manufacturer rating of 40 consecutive days of submergence at a maximum depth of 40 feet.
 - 9) Capable of operating in air 100 percent of time with no external cooling required.
 - 10) No fan cooling during operation.
 - 11) Utilize ceramic shaft seal requiring no oil lubrication.
12. Identification:
 - a. Corrosion resistant nameplate affixed to Top Cover of grinder.
 - b. Nameplate Information: Manufacturer's name and address, Model No., Serial No., Capacity, Max. psi, Weight, Manuf. Date.
13. Finishes:
 - a. Paint Coatings for Ferrous Materials: Prepared to SSPC-SP6 (Commercial Blast Cleaning) and coated with minimum 6 to 8 mils TDFT (total dry film thickness) of an aliphatic acrylic polyurethane paint in the color Hunter Green.
 - b. Paint Coatings for Previously Coated Components (Motors, Speed Reducers, etc.): Prepared to SSPC-SP1 (Solvent Cleaning) and SSPC-SP2 (Hand Tool Cleaning) and coated with minimum 6-8 mils TDFT (total dry film thickness) of an aliphatic acrylic polyurethane paint in the color Hunter Green.

D. SOLIDS DIVERTER

1. Design: Rotating cylindrically formed stainless steel perforated screen drum mounted vertically between two housings containing

- mechanical seal and bearing cartridges driven by an electric motor with a cycloidal speed reducer to provide a rotational speed of 5 rpm.
2. Perforated Screen Drum
 - a. Screen cylindrically formed using ½ inch diameter holes with a nominal 50% open area across the surface of the screen.
 - b. Screen deburred and electropolished AISI 304 stainless steel.
 - c. Trunnions top and bottom of drum ASTM A564 Grade 630 condition H1150 (17-4) stainless steel.
 3. Mechanical Seal and Bearing Cartridges
 - a. Seals and bearing incorporated into a cartridge style design requiring no external seal flush or lubricants to operate wet or dry.
 - b. Rated for over 6X maximum operating depth or 150 psi.
 - c. Secondary lip seal with grease barrier.
 - d. Dynamic and Static seal faces to be Tungsten carbide with 6% nickel binder.
 - e. Cartridge bushing and housing are AISI 304 stainless steel.
 - f. O-rings to be Viton (Fluorocarbon).
 4. End housings
 - a. Cast ASTM A48 Class 30 gray iron.
 5. Shrouds and Covers
 - a. Shrouds
 - 1) Glass bead blast and passivate AISI 304L stainless steel.
 - b. Cover
 - 1) Manufacturing identification plate mounting on surface.
 - 2) Glass bead blast and passivate AISI 304L stainless steel.
 6. Drum Baffle/ Channel Seal and Brush
 - a. Drum Baffle
 - 1) Glass bead blast and passivate AISI 304L stainless steel.
 - b. Channel Seal
 - 1) Buna-N rubber 60A durometer.
 - c. Brush
 - 1) Nylon bristles with PVC base
 7. Couplings
 - a. Low Speed Coupling
 - 1) Two-piece design with interlocking lobes.
 - 2) Hardened AISI 4140 alloy steel
 - b. High Speed Coupling
 - 1) Type L 3-jaw with elastomer
 - 2) Buna-N spider.

8. Lifting Brackets
 - a. AISI 304 stainless steel.
9. Speed Reducer
 - a. Grease lubricated cycloidal design Cyclo Series 6000 with 377:1 reduction ratio.
 - b. Manufacturer: Sumitomo Machinery Corporation of America.
10. Motor
 - a. XPNV Immersible Motor: Baldor Electric Company.
 - 1) Installed Horsepower: 1 HP.
 - 2) Motor Service Factor: 1.15.
 - 3) Minimum Motor Efficiency (at Full Load): 85.5 percent.
 - 4) Minimum Motor Power Factor (at Full Load): 80.
 - 5) UL rated NEMA 6P, Class I, Div. 1 Groups C&D, Class II Div. 2, Groups F&G, Class III Div. 1.
 - 6) Manufacturer rating of 40 consecutive days of submergence at a maximum depth of 40 feet.
 - 7) Capable of operating in air 100 percent of time with no external cooling required.
 - 8) No fan cooling during operation.
 - 9) Utilize ceramic shaft seal requiring no oil lubrication.
11. Extended Shaft and Spool Assembly
12. Identification:
 - a. Corrosion resistant nameplate affixed to Top Cover of Solids Diverter.
 - b. Nameplate Information: Manufacturer's name and address, Model No., Serial No., Capacity, Max. psi, Weight, Manuf. Date.
13. Finishes:
 - a. Paint Coatings for Ferrous Materials: Prepared to SSPC-SP6 (Commercial Blast Cleaning) and coated with minimum 6 to 8 mils TDFT (total dry film thickness) of an aliphatic acrylic polyurethane paint in the color Hunter Green.
 - b. Paint Coatings for Previously Coated Components (Motors, Speed Reducers, etc.): Prepared to SSPC-SP1 (Solvent Cleaning) and SSPC-SP2 (Hand Tool Cleaning) and coated with minimum 6-8 mils TDFT (total dry film thickness) of an aliphatic acrylic polyurethane paint in the color Hunter Green.

E. MOTOR CONTROLLER

1. Design:
 - a. Enclosures shall be as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.

- b. Motor Controller to include programmable logic controller (PLC), Operator Interface Terminal (OIT) for status information and operating parameter configuration, operation and fail indicators, and selector switches.
- 2. Basis of Design:
 - a. Model# PC2222 as manufactured and supplied by JWC Environmental, Inc., or equal.
 - b. Motor Controller Power Supply: 460 V/ 3 PH/ 60 Hz.
- 3. Enclosure, Selector Switches, Pushbuttons and Pilot Lights
 - a. Enclosure
 - 1) Enclosures shall be as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings. **RATED FOR HAZARDOUS LOCATION**
 - 2) 316 S/S (36 in. x 30 in. x 12 in.) with hinged door, single handle with 3 point latch (no screw clamps) and mounting flanges.
 - 3) Integral Disconnect: Provide integral through the door disconnect switch that is lock outable.
 - 4) Main Circuit Breaker: Provide main circuit breaker inside panel
 - 5) Selector Switches:
 - a) Grinder
 - 22 mm, three-position, rated equal or better than the enclosure.
 - Indicate ON-OFF-REMOTE.
 - a) Screen
 - 22 mm, three-position, rated equal or better than the enclosure.
 - Indicate ON-OFF-AUTO.
 - 6) Pushbuttons
 - a) EMERGENCY STOP
 - 22mm, maintained.
 - a) RESET
 - 22mm, momentary.
 - 7) Pilot Lights:
 - a) 22 mm, LED (pilot lamp), rated equal or better than the enclosure
 - a) Indicate POWER ON, GRINDER RUN, SCREEN RUN and FAIL.
- 4. Programmable Logic Controller
 - a. 100kB working memory, (14) 24Vdc inputs, (10) relay outputs and (2) 0-10Vdc analog inputs.
 - b. PROFINET interface.
 - c. Manufacturer: ~~Siemens~~ **Allen-Bradley**
- 5. Operator Interface Terminal
 - a. Key/ touch operation, 4 in. widescreen TFT display.

- b. 4 MB configuration memory.
 - c. PROFINET interface.
 - d. SD card slot.
 - e. NEMA 4X suitable for in direct sunlight. **Provide sun shield.**
- 6. Motor Starters, Overload Relays and Control Power Transformer:
 - a. Starters
 - 1) IEC, full voltage, and reversing.
 - b. Overload Relays
 - 1) Adjustable and sized to full load amperes (FLA) of the motor.
 - c. Control Power Transformer
 - 1) Produce 120-volt AC power from the supply power. Sized and fused in accordance with code to accommodate the control power requirements.
- 7. Current Transducers
 - a. 0-10VDC analog output.
- 8. Operation:
 - a. Grinder Control: In accordance with ON-OFF-REMOTE selector switch setting.
 - 1) OFF Position: Grinder will not run. Motor controller faults to be cleared with RESET pushbutton.
 - 2) ON Position: Grinder will run forward.
 - 3) REMOTE Position: Grinder operates as controlled by a remote start/stop dry contact.
 - b. Solids Diverter Control: In accordance with ON-OFF-AUTO selector switch setting.
 - 1) OFF Position: Solids Diverter will not run. Motor controller faults to be cleared with RESET pushbutton.
 - 2) ON Position: Solids Diverter will run forward.
 - 3) AUTO Position: Solids Diverter operates as controlled by Grinder operation.
 - c. Emergency Stop: In accordance EMERGENCY STOP pushbutton depressed:
 - 1) Control circuit de-energizes the PLC outputs to all motor starters, causing the coils of all motors starters to be de-energized.
 - 2) Fail relay energizes. OIT will display message: [Emergency Stop Activated].
 - 3) Emergency Stop condition only cleared locally by resolving the issue, resetting the EMERGENCY STOP switch and depressing the RESET pushbutton.
 - d. No current sensed at Grinder Motor running condition: Controller will activate FAIL indicator and OIT will display message: [Grinder Fail to Run].

- e. No current sensed at Solids Diverter Motor running condition: Controller will activate FAIL indicator and OIT will display message: [Solids Diverter Fail to Run].
- f. Grinder JAM Condition: Controller will stop the Grinder, reverse rotation of Grinder to clear the obstruction.
 - 1) If obstruction is cleared, controller will return Grinder to normal operation.
 - 2) If three reverses occur within a 30 second interval, controller will stop the Grinder and Solids Diverter motors, activate the FAIL indicator and relay. OIT will display message: [Grinder Jammed].
- g. Solids Diverter JAM Condition: Controller will stop the Solids Diverter and reverse rotation to clear the obstruction.
 - 1) If obstruction is cleared, controller will return Solids Diverter to normal operation.
 - 2) If two reverses occur within a 30 second interval, controller will stop the Solids Diverter motor and activate the FAIL indicator and relay. OIT will display message: [Solids Diverter Jammed].
 - 3) Grinder will continue to operate.
- h. Grinder MOTOR OVERLOAD Condition: Motors will be de-energized.
 - 1) The FAULT indicator lamp will be illuminated, and the FAIL contact will be closed. OIT will display message: [Grinder Motor Overload].
 - 2) Grinder and Solids Diverter will stop operation.
- i. Grinder MOTOR OVERTEMP Condition: Motors will be de-energized.
 - 1) The FAULT indicator lamp will be illuminated, and the FAIL contact will be closed. OIT will display message: [Grinder Motor Overtemp.].
 - 2) Grinder and Solids Diverter will stop operation.
- j. Solids Diverter MOTOR OVERLOAD Condition: Motor will be de-energized.
 - 1) The FAULT indicator lamp will be illuminated, and the FAIL contact will be closed. OIT will display message: [Solids Diverter Motor Overload].
 - 2) Solids Diverter will stop operation.
 - 3) Grinder will continue to operate.
- k. Solids Diverter MOTOR OVERTEMP Condition: Motor will be de-energized.
 - 1) The FAULT indicator lamp will be illuminated, and the FAIL contact will be closed. OIT will display message: [Solids Diverter Motor Overtemp.].
 - 2) Solids Diverter will stop operation.
 - 3) Grinder will continue to operate.

1. Power Failure:
 - 1) While System is Operating: System shall return to normal operation when power is restored.
 - 2) While System is in a Fail Condition: System shall return to a fail state when power is restored. The fail state shall not be cleared until reset.
- m. Reset of Grinder and Solids Diverter: Accomplished from the controller only.

2.3 TOOLS AND SPARE PARTS

- A. Manufacturer shall furnish a list of additional recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Manufacturer's representative shall field test and calibrate the equipment to assure that the system operates to the OWNER'S satisfaction.

3.2 FIELD QUALITY CONTROL

- A. All equipment will be given running tests by CONTRACTOR at the Site following installation of the equipment and controls. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately and is ready for permanent operation.
- B. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 1 visit, minimum 2 hours on-Site visit. Site. The visit shall be for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- C. Field training for operations, maintenance, and supervisory staff members is to be provided by a factory or manufacturer's representative for a minimum of 1 visit, for 2 hours for field instructions.. Field instruction shall

cover key components of the equipment, operating and maintenance requirements and troubleshooting techniques.

- D. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

END OF SECTION

SECTION 11539

SUBMERSIBLE PUMPS

PART 1 - General

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish and install solids handling submersible pumps complete and operational with motors, discharge connections, lifting chains, guide bars motors, control equipment, and accessories as shown and specified. Anchorage devices are included in the scope of this Section.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before submersible pump Work.

C. Related Sections:

1. Section 05051, Anchor Systems.
2. Section 09900, Painting.
3. Section 15060, Piping and appurtenances.
4. Division 17, Instrumentation

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/HI 9.1-9.5, Standard for Pumps – General Guidelines for Types, Definitions, Application, Sound Measurement, and Decontamination
2. ANSI/HI 9.8, Pump Intake Design
3. ANSI/HI 11.6, Submersible Pump Tests
4. ANSI/HI 14.6, Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests
5. IEEE 85, Airborne Sound Measurements- Rotating Electrical Machinery
6. NEMA MG-1, Motors and Generators

1.3 QUALITY ASSURANCE

A. Supplier's Qualifications:

1. Supplier shall have a minimum of five years experience producing substantially similar equipment to that required for the Project and

shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section, regardless of component Supplier, from one submersible pump manufacturer.
2. Submersible pump Supplier shall review and approve or prepare all Shop Drawings and submittals for all components provided under this Section.
3. All components shall be suitable for specified service conditions and shall be integrated into overall assembly by the submersible pump Supplier.

C. Certifications

1. Certification of Compliance:

- a. Obtain certification of compliance with the Contract Documents from the submersible pump manufacturer on manufacturer letterhead; certification by manufacturer's representatives is not acceptable.
- b. Certification shall be worded as follows:
“[Insert manufacturer's name] proposes to supply equipment included in Section 11539 for the Flint River Pump Station Project in Fulton County, Georgia for the City of Atlanta Department of Watershed Management. We have examined the Contract Documents and understand of the Project requirements insofar as they affect the proposed products. We certify that the products will operate satisfactorily under the conditions described in the Contract Documents and that the products meet the requirements of the Contract Documents:
[List exceptions, deviations or changes necessary or recommended to accommodate the proposed products.]
We further certify that the products to be furnished shall conform to the standards listed in Section 11539, Submersible Pumps, of the Contract Documents.
[List exceptions, deviations or changes necessary to accommodate the proposed products.]
Authorized Signature & Title _____ Date”
- c. Provide justification for exceptions, variations, deviations, or changes. ENGINEER will determine whether exceptions, deviations, and changes are acceptable. Exceptions, variations, deviations, and changes may result in rejection of products.
- d. Provide certification before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of certification.
- e. Acceptance of certification shall not relieve CONTRACTOR of responsibility for adequacy of all products.

- f. Submittal of certification shall not relieve CONTRACTOR and Supplier of requirement to comply with submittal procedures in the Contract Documents.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Shop Drawings of pump controls specified in this Section, including panel layout and wiring diagrams. Conform to Shop Drawing submittal requirements of Division 17, Instrumentation and Control for Process Systems and Submittal requirements in Division 01.

2. Product Data:

- a. Manufacturer's literature, illustrations, specifications, paint certification (if required) and engineering data including; dimensions, materials, size, weight, and part lists for all components in sufficient detail to allow an item-by-item comparison with the Contract Documents.
- b. Pump performance data and curves showing overall pump efficiencies, required net positive suction head (NPSH), allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head. Curves shall range from minimum flow to shut-off head at for full speed and all speed curves specified. For variable speed units, curves shall have at least five speeds plotted between maximum and minimum rpm. Curves shall indicate Preferred Operating Region (POR) and Allowable Operating Region (AOR), as defined in ANSI/HI 9.6.3. Specify recommended ratio of available NPSH divided by required NPSH for water service.
- c. Motor Data: Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified, including the following:
 - 1) Manufacturer and application.
 - 2) Type and frame size.
 - 3) Speed-torque relationship.
 - 4) Efficiency at 1/2, 3/4, and full load.
 - 5) Power factor at 1/2, 3/4, and full load.
 - 6) Slip at full load.
 - 7) Running light, full load and locked rotor current.
 - 8) Temperature rises and results of dielectric tests.
 - 9) Bearing type and lubrication medium
 - 10) Insulation class and temperature ratings.

3. Testing Plans, Procedures, and Testing Limitations:

- a. Provide pump Supplier's proposed shop testing plan, including complete list of testing facility limitations.

- b. Provide proposed field testing plan.
- B. Informational Submittals:
 - 1. Certificates: Provide certificate of compliance as specified in this Section.
 - 2. Manufacturer Instructions:
 - a. Provide Supplier's instructions for handling and installing products.
 - b. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
 - 3. Source Quality Control Submittals:
 - a. Results of shop testing for complete pump and motor unit.
 - b. Location of nearest permanent service headquarters of pump manufacturer to the Site.
 - 4. Field Quality Control Submittals:
 - a. Results of field testing.
 - b. Submit a written report of the results of each visit to Site by pump manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.
 - 5. Qualifications Statements:
 - a. Provide Supplier's qualifications as specified in Quality Assurance article of this specification.
- C. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Manuals:
 - a. Submit complete operation and maintenance manuals, including shop and field test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Provide operation and maintenance manuals per Division 01 requirements.
 - 2. Warranty Documentation:
 - a. The pump manufacturer shall provide a 5-year non-prorated warranty for the pumps from the date of beneficial use, not to exceed eighteen (18) months from date of installation, that the structure and all equipment he provides shall be free from defects in material and workmanship.
 - b. In the event a pump component fails to perform as specified or is proven defective in service during the warranty period, the Manufacturer shall repair or replace, at his discretion, such defective part. Manufacturer shall provide, without cost, any labor required to replace, repair, or modify the pumps.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. See spare parts list below.

2. Tools:
 - a. Furnish two sets of special tools required for normal operation and maintenance of products furnished.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Prior to shipping, completely inspect products to assure that components are complete and comply with all requirements. Box or crate products as required to prevent damage during shipment. Protect machined surfaces and matching connections to prevent damage.
 2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 3. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
 4. Comply with Division 01 product delivery requirements.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification.
 2. Keep all products off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.
 3. Store mechanical equipment in covered storage off the ground and prevent condensation.
 4. Comply with Division 01 product storage and handling requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. System Description:
 1. Pumps shall be submersible type. Pumps shall be constructed for operation under complete submersion, partial submersion, and dry conditions. Each pump shall be suitable for its intended service.
 2. Pumps shall comply with ANSI/HI 14.6, ANSI/HI 9.6.3, and ANSI/HI 9.8.

B. Size and Service Conditions

Pump ID	Pump 1.1-1.4	Pump 1.5-1.6	Pump 5.1-5.3	Pump 5.4-5.5
Location:	Influent Pump Station		Effluent Pump Station	
Use:	Sanitary Sewer Pumping			
Fluid Pumped:	Raw Sanitary Sewage			

Pump ID	Pump 1.1-1.4	Pump 1.5-1.6	Pump 5.1-5.3	Pump 5.4-5.5
Pump Type:	Variable Speed Submersible	Variable Speed Submersible	Variable Speed Submersible	Constant Speed Submersible
Number Required:	4	2	3	2
Min. Sphere Diameter (in):	3	3	3	3
Discharge Nozzle Dia. (in.):	8	10	8	12

C. Design and Performance Criteria: Each pump shall comply with the following

Pump ID	Pump 1.1-1.4	Pump 1.5-1.6	Pump 5.1-5.3	Pump 5.4-5.5
Location:	Influent Pump Station		Effluent Pump Station	
*Design Flow (gpm)	1,947	3,700	2,200	7,100
*TDH at Design Flow (ft)	42	44	54	110
Minimum Efficiency at Design Flow (%)	79%	81%	81%	80%
NPSHa at Design Flow (ft)	32.4	32.4	31.8	31.8
Maximum Pump Speed	1150	1150	1150	1185
Horsepower	34	54	44	280
Variable Speed Operation:				
Minimum Operating Speed	967	1,007	908	-
Minimum Flow (gpm)	1,180	2,600	1,250	-
Head at Minimum Flow (ft)	32	36	37	-
Notes: *Guaranteed duty point at maximum speed per HI 11.6 Grade 1B. Measured at pump discharge flange at maximum speed. **Required NPSH shall be for size impeller furnished. If impeller is trimmed, provide curve for impeller as trimmed.				

D. Motor Requirements

Pump ID	Pump 1.1-1.4	Pump 1.5-1.6	Pump 5.1-5.3	Pump 5.4-5.5
Location:	Influent Pump Station		Effluent Pump Station	
Motor Size (hp)	34	54	44	280
Nominal Speed (rpm):	1180	1185	1185	1185
Motor Voltage/Phase/Hertz	460/3/60			
Motor Cooling System	Closed Loop			
Efficiency Rating	Premium	Premium	Premium	Premium
Motor Protective Devices:	4	2	3	2
Thermal Over temperature	Standard			
Seal Chamber Moisture Sensor	Standard			
Cable Entry Housing Moisture Sensor	Y	Y	Y	Y
Stator RTD	Y	Y	Y	Y
Drive-end Bearing RTD	N	N	N	Y
Tri-axial Vibration Sensor	N	N	N	Y

2.2 MANUFACTURERS

A. Products and Manufacturers: Provide products of one of the following:

1. Flygt Corporation.
2. Or Equal.

2.3 DETAILS OF CONSTRUCTION

A. General:

1. Construct pumps for fluid service specified.
2. Construct pumps and appurtenances, including discharge pipes, guide bars, cable holder lifting chains, and cable, for continuous submerged operation without loss of watertight integrity to depth shown on the Contract Drawings.

B. Pump and Motor Casing:

1. Pump and Motor casings shall be grey cast iron, A48 Class 30, of sufficient strength, weight, and metal thickness to ensure accurate alignment and prevent excessive deflection.
2. Volute to be centerline discharge style.
3. Provide ribs or reinforcing if required to withstand the specified hydrostatic test pressure or to prevent deflection caused by hydraulic thrust.
4. Volute to have smooth, unobstructed fluid passages large enough to pass solids of the specified size and devoid of blowholes and other irregularities.

5. For mating parts, provide machined tongue-and-groove or rabbeted surfaces for accurate and permanent alignment.

C. Impeller:

1. Type: Single suction solids handling type of the enclosed radial, enclosed mixed flow, or semi-open single vane configuration.
2. Provide vanes having wide suction and waterways that will pass solids and stringy material without clogging.
3. Provide pumps capable of passing a 3-inch solid sphere size
4. Pumps capable of only passing a deformable sphere are not acceptable.
5. Impeller balance ports/holes are not acceptable for thrust reduction.
6. Impeller to be keyed to the motor shaft and secured to the shaft with by a streamlined bolt or locknut capable of holding in event of motor reversal under full torque.
7. Impeller Fastener: Type 416 stainless steel or Type 316Ti stainless steel
8. Design impeller fastening system to accept full reverse flow upon pump shut down.
9. Statically and dynamically balance each impeller.
10. Semi-Open Impellers:
 - a. Type: Semi-open, solids handling, multi vane
 - b. Material:
 - 1) High chrome Cast Iron, ASTM A532, Class III, Type A (25% Chrome)

D. Wear Rings:

1. Provide adjustable wear plate mounted to volute.
2. Design wear plate to shred and pass stringy solids outward from the impeller.
3. Provide suction flange integral to the wear plate and drilled and tapped to accept ANSI class 125 flanged fittings.
4. Materials:
 - a. Wear plate: Match impeller material
 - b. Wear Plate Fasteners: Type 416 stainless steel or Type 316Ti stainless steel.

E. Pump Shaft

1. Pump shaft shall be stainless steel, ASTM A276 400 Series, turned, ground and polished, of proportions suitable for use in the specified application.
2. Pump shaft shall be designed to provide sufficient stiffness to operate without distortion or damaging vibration throughout the range of service specified.

F. Mechanical Seals:

1. Provide two separate tandem-mounted mechanical seals with the upper and lower seals mounted to rotate in the same direction.
2. Upper seal is to isolate the motor from the seal chamber; lower seal isolates the seal chamber from the pumped fluid.
3. Each seal is to have separate springs and positively driven rotating members.
4. Mechanical seal system to run in oil-filled chamber with the seal faces completely immersed in oil.
5. Materials:
 - a. Upper Seal: Silicon carbide rotating and stationary faces.
 - b. Lower Seal: Silicon carbide rotating and stationary faces.
 - c. Springs: Type 316 stainless steel
 - d. Elastomers: Viton.

G. Motors

1. Enclosure: Motor casing to be air or oil-filled, watertight, and jacketed.
 - a. U/L Listed or FM certified for operation in Class I, Division I, Group D atmosphere.
 - b. Submergence rating: 65 Feet
2. Sized to be non-overloading at any point on the pump performance curve.
3. Service Factor: 1.15
4. Design: NEMA Design B, normal starting torque, normal slip, squirrel cage induction type, continuous duty.
5. Materials of Construction:
 - a. Stator Housing, seal housing, and cable entry/cap assembly to be cast iron ASTM A48, Class 25 or better.
 - b. Cooling jacket: 316 Stainless steel.
 - c. Mating surfaces machined and fitted with O rings.
 - d. Provided a 316 SS lifting bail securely attached to stator housing, sized to lift, and lower the fully assembled pump and motor assembly. Alternatively, provide a lifting eye cast into the cable entry/cap assembly.
6. Pump/Motor Shaft: Type 416 or Type 420 stainless steel or ASTM A576 Cr 1040 with Type 420 stainless steel sleeve.
7. Insulation:
 - a. Moisture-resistant Class F with Class B temperature rise, 40 degrees C ambient.
 - b. Motors for use with variable frequency drives shall have insulation system constructed in compliance with or exceeding NEMA MG-1 Part 31.
8. Motor Cooling System:
 - a. Furnish submersible motor cooling system as noted in the Specific Motor Requirements. Cooling system to meet the following requirements:

- 1) Closed-Loop Cooling: Provide motor with an integral closed-loop motor cooling system consisting of a circulating pump driven by the pump shaft, a stainless steel motor cooling jacket that encircles the stator housing, and an integrated heat exchanger to transfer the motor heat to the process fluid.
 - 2) Cooling system is to circulate a non-toxic oil or glycol-water mixture through the cooling jacket surrounding the motor.
 - 3) Design the cooling system to dissipate the motor heat regardless of the type of pump installation.
 - 4) The cooling system impeller is to provide the necessary circulation of the cooling liquid through the jacket.
 - 5) Provide the cooling system with a minimum of one fill port and one drain port integrated into the cooling jacket.
9. Bearings:
- a. Upper bearings (non-drive end):
 - 1) Lubrication: Grease -permanently lubricated
 - 2) Quantity: Single row
 - 3) Type: Ball bearings
 - b. Lower Bearings (drive end):
 - 1) Lubrication: Grease -permanently lubricated
 - 2) Quantity: Double row
 - 3) Type: Angular contact ball bearings
 - c. Bearings to have a minimum L10 “rating life” of 50,000 hours per ABMA 9 under all loading conditions of pump operation from zero head to shut off.
 - d. Bearings are to be insulated/isolated to prevent bearing currents when motor is powered by a VFD.
10. Dynamically balance rotor to within NEMA vibration limits.
11. Motors to be equipped with a terminal board with threaded compression type binding posts for power cable connection. Terminal board to be in separate junction chamber sealed from stator housing.

H. Submersible Cable and Cable Sealing

1. Motor Cable:
 - a. Chloroprene rubber jacketed cable clearly marked for submersible duty by code or legend permanently applied to cable.
 - b. Multi-conductor SOW-A, G-GC or W submersible service cable in one continuous length from pumping unit to the terminal junction box.
 - c. Size cable in accordance with NEC specifications.
2. Cable Seals:

- a. Provide all power and control lead wires double sealed entering the motor in a method that prevents cable wicking.
 - b. Provide the sealing system consisting of a double rubber grommet to seal the cable exterior followed by interior epoxy seal.
 - c. Provide a cable strain relief mechanism as an integral part of this sealing system.
 - d. Provide the cable sealing system capable of withstanding an external pressure test of 1,200 psi as well as a cable assembly pull test as required by UL or FM.
 - e. Provide the cable entry rated by UL or FM for submerged operating depths specified.
 - f. Singular grommet or other similar sealing systems are not acceptable.
3. Pump Protective Devices and Sensors:
- a. Provide pump motor with the following standard protection devices:
 - 1) Thermal Protection: Equip motor with three (3), normally closed, thermal switches (one for each phase) embedded in the coils of the stator windings. Switches to open on rise in temperature.
 - 2) Moisture Protection: Furnish seal chamber moisture sensor.
 - 3) Provide a thermal sensor (RTD) embedded in one phase of the stator to monitor the stator temperature.
 - 4) Provide a leakage sensor mounted in the terminal connection housing to monitor any leakage thru the cables and the cable entries.
 - 5) Provide a solid-state relay to monitor the status of all sensors provided with the pump.
 - a) Relay is to be mounted in the local control panel or in the MCC bucket providing power to the pump – refer to the project electrical and I&C drawings for relay location. Coordination is required between the pump manufacturer and the control system/electrical system suppliers.
 - a) Protective relay is to trip the pump off or alarm as required by the pump manufacturer to maintain the pump warranty in full force and affect.
 - b. Provide separate submersible power and control cables for motor protective control devices specified. Alternatively, power and control conductors can be part of the pump power cable. If a separate cable is provided, the cable is to meet the same specification requirements as the pump power cable.

4. Motor shall have a stainless steel nameplate which shall provide the following: type, frame, insulation, class, HP, full load current, RPM, centigrade degree rise, manufacturer's name and serial number model, voltage, locked rotor KVA code, bearing numbers, and a connection diagram.
- I. Accessories: Provide the following for each pump unless otherwise specified.
1. Nameplate:
 - a. Securely fasten to each pump brass or stainless steel nameplate engraved with pump manufacturer's name, pump model and serial number, pump's rated flow and head, speed, and other pertinent data.
 2. External Hardware:
 - a. Bolts, nuts, and cap screws shall have hexagonal heads and be Type 316 stainless steel.
 - b. Anchor bolts and anchorage devices per Section 05051, Anchor Systems.
 3. Discharge Elbow:
 - a. Provide an ASTM A48 Class 30 cast iron discharge base assembly including a 90-degree elbow and base to support the entire weight of the pump and motor and to secure the lower end of the guide rails.
 - b. Outlet: Flanged, ANSI Class 125, flat faced.
 - c. Provide base machined to receive sliding bracket of pump discharge.
 - d. Provide seat constructed of bronze or non-metallic O-ring that is self-cleaning, non-clogging and non-sparking UL or FM certified explosion-proof.
 - e. Bolt to floor with Type 316 stainless steel anchors.
 4. Guide Rails and Brackets:
 - a. Provide sliding guide bracket of coated cast iron or steel.
 - b. Provide schedule 40, Type 316L, stainless steel guide rails or Type 316 cables for each pump discharge assembly. Guide rails are to be manufacturer's recommended size but not less than 2-inches in diameter.
 - c. Provide Type 316L stainless steel top guide rail retainer brackets to support the guide rails or cables. Bracket to be attached to top slab of wet well.
 - d. Lower guide bar support to be integrally cast boss on discharge elbow, arranged so that guide bar is held in position by sliding over boss.
 - e. Provide intermediate guide bar supports, fabricated from Type 316 stainless steel when guide bars exceed 10-feet in length. Bolts to be Type 316 stainless steel.
 5. Lift Chain:

- a. Furnish for each unit a Type 316 stainless steel chain of sufficient length, to reach from the pump mounted on the discharge elbow to the top of wet well plus 10 feet.
 - b. Chain strength and size determined by pump manufacturer, but no less than 150% of the pump weight.
 - c. Furnish stainless steel attachments to the lifting bail provided on motor and to the guide rail retainer bracket.
- 6. Cable Grips:
 - a. Furnish S.S. cable grips for the submersible power cable(s). Kellems or equal.
- 7. Sump Mixing Valve
 - a. One pump unit in each pump station shall be equipped with an automatically operating flush valve mounted directly to the pump volute. During the starting the valve shall redirect a portion of the pumped media into the sump to re-suspend solids and grease by the turbulent action of its discharge.
 - b. The valve shall be equipped with an adjustable, wear-resistant discharge nozzle that can be used to direct flow within the sump. The valve shall operate by differential pressure across the valve and shall not require any electric or pneumatic power source to operate. The valve shall be suitable for use in Class I, Division 1 hazardous locations.
 - c. The valve shall open at the beginning of each pumping cycle and shall automatically close during the pump operation after a pre-set time. A method of adjusting the valve operating time shall be provided.

2.4 CONTROLS

- A. The equipment provided under this Section will be controlled by the Pump Station Control System (PSCS) that is provided under Division 17, Instrumentation and Control for Process Systems. All field signals shall be wired to the Pump Station Control Panel (PSCP) that is part of the PSCS. The PSCP will be equipped with a Programmable Logic Controller (PLC) that will be programmed by the I&C Subcontractor. Equipment manufacturer shall coordinate with the I&C Subcontractor for programming the proper control and operation of the equipment.
- B. Provide power and control cables and motor protective control devices as specified in this Section.
- C. Local control stations shall be provided as shown on the Process and Instrumentation Diagrams and as specified in Division 17.

2.5 FINISHING

- A. Shop Finishing:
 - 1. At the factory, pumps, motors, and appurtenances shall receive manufacturer's standard finish paint system suitable for service conditions specified in this Section. Finish color of pumps in dry pit service shall be same as color of related process piping.
 - 2. Coat machined, polished, and non-ferrous surfaces with corrosion prevention compound.
- B. Field painting shall conform to Section 09900, Painting. Touch-up of factory-applied finishes shall be compatible with factory-applied finish and specified service conditions.

2.6 SOURCE QUALITY CONTROL

- A. Pump Shop Tests: Shop Test all pumps provided under this Section.
 - 1. Hydrostatic testing:
 - a. Test pressure is to be to the greater of twice the specified TDH at the design flow, or 1.5 times pump's shutoff head.
 - 2. NPSH3 Testing Type: Type 3
 - 3. Performance Test:
 - a. Testing of submersible pumps dry is not acceptable.
 - b. Test pump at full speed.
 - c. Operate each pump assembly from zero to maximum capacity as shown on pump curve in approved Shop Drawing. Present results of test in plot of test curves showing head, flow, horsepower, efficiency, and current. Obtain data at minimum of five evenly spaced capacity points along curve including shut off, design points, and minimum head for which pump is designed to operate. Conduct tests per ANSI/HI 1.6 and ANSI/HI 11.6.
 - d. Testing Grade:
 - 1) Follow testing grade in Design Performance Criteria Table Above
 - 4. Motor Tests and Data:
 - a. Provide the following motor tests in accordance with ANSI/HI 11.6
 - 1) Test motor integrity in a submerged condition.
 - 2) Dry run no-load test.
 - 3) Motor electrical integrity test.
 - 4) Moisture and temperature sensors integrity test.
 - 5. Each test shall be witnessed by professional engineer, registered and licensed in the state where pumps are fabricated, who may be an employee of pump manufacturer. Professional engineer shall sign, date, and seal all copies of test results and shall certify that hydrostatic tests were performed. Professional engineer's name and registration number shall be clearly legible on the seal.

6. Upon satisfactory completion of the witnessed tests, prepare certified test curves and submit to the Engineer for final approval.
7. Do not ship products from factory until ENGINEER has accepted test results.

2.7 SPARE PARTS

- A. Provide all applicable pump spare parts including the following:
 1. One (1) mechanical seal assembly.
 2. One (1) set of gaskets and O-ring seals.
 3. One (1) set of wear rings (impeller and casing).
 4. One set of special tools required for normal maintenance or operation.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install products in conformance with manufacturer's instructions and recommendations, and the Contract Documents.
- B. Anchorages:
 1. Install pumps on concrete bases. Provide anchorages in new or existing concrete, as applicable, per equipment manufacturer's recommendations and the Contract Documents. Equipment manufacturer shall supply templates to facilitate location of anchorages for equipment. CONTRACTOR shall coordinate with Supplier to assure timely receipt of required templates.
 2. For pumps installed in dry pit applications, install grout between pump and concrete base per recommendations of pump manufacturer.
- C. General:
 1. Set products accurately in location, alignment, and elevation, plumb and true.
 2. Guide Rails: Install guide rails plumb and parallel. Install intermediate supports when rail lengths exceed specified maximums.
 3. Field painting shall conform to Section 09 91 00, Painting.
 4. Provide all fluids/lubricants recommended by equipment manufacturer for initial operation.

5. Verify that piping, valves, and utilities are tested and operational before placing equipment into operation.
6. Prior to energizing motor, rotate drive motor by an external source to demonstrate free operation of mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional
7. Adjust free length of power cable to minimize movement with pump in place.
8. Align and adjust products and piping in presence of ENGINEER.
9. Install cable grips on the submersible cables and attach to a SS eyebolt installed in the vertical face of the concrete under the access hatch. Loop the submersible cable from the grips, under the roof, and up through the conduit to the Local Control Panel.
10. Field painting shall conform to Section 09900, Painting.
11. Conform to Checkout and Startup Procedures Division 01, General Requirements.

3.3 FIELD QUALITY CONTROL

A. Site Tests:

1. Following installation, CONTRACTOR and qualified field service representative of equipment manufacturer shall conduct operating tests of all equipment, functions, and controls at Site, in presence of ENGINEER. Should tests result in malfunction, make necessary repairs, revisions, and adjustments and restart test from beginning. Repeat tests and repairs, revisions, and adjustments until, in opinion of ENGINEER, installation is complete and equipment is functioning properly and accurately, and is ready for permanent operation.
2. Conform to Division 01, General Requirements.
3. Field Operating Test:
 - a. Field test equipment and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part and component of system individually and all parts and components together function properly in manner intended. Total duration of testing shall be 8 hours, continuous and uninterrupted, in automatic mode. All testing equipment and manpower shall be by CONTRACTOR.
 - b. Conform to applicable provisions of ANSI/HI 9.6.5.

B. Manufacturer's Services: Provide qualified, factory-trained serviceman to perform the following:

1. Instruct CONTRACTOR in installing equipment.
2. Inspect and adjust equipment after installation and ensure proper operation.
3. Test-operate the products in presence of ENGINEER and verify that equipment conforms to Contract Documents.

4. Instruct OWNER's personnel in operating and maintaining the products.
5. Manufacturer's representative shall make a minimum of 3 visits, with a minimum of 8 hours onsite for each visit. First visit shall be for assistance in installing equipment; second visit shall be for checking completed installation and start-up of system; third visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.
6. Training: Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of products. Training requirements, duration of instruction, and other qualifications shall be per Division 01, General Requirements.
7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to Site shall be included in the Contract Price.

END OF SECTION

SECTION 14300

FREESTANDING JIB CRANE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Freestanding Base Plate Mounted manually operated jib crane.
- B. Related sections:
 - 1. Section 14310 - Hoists: Motorized Electric trolley and hoist to be installed in jib crane boom.
 - 2. Division 16: Electrical supply, conduit, wiring, and other electrical components for powering motorized trolley and hoist on crane.

1.2 REFERENCES

- A. American Institute of Steel Construction (AISC): Manual of Steel Construction, Part 5, Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
- B. American National Standards Institute (ANSI):
 - 1. ANSI B30.11 - Monorails and Underhung Cranes.
- C. CMAA Specification 74
- D. American Society for Testing and Materials (ASTM) Publications:
 - 1. ASTM A36 - Carbon Structural Steel.
 - 2. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength.
 - 3. ASTM A490 - Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
- E. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code.
- F. Occupational Safety and Health Administration (OSHA): OSHA Specification 1910.179 - Overhead and Gantry Cranes.

1.3 PERFORMANCE REQUIREMENTS

- A. Crane shall consist of a rotating steel beam boom covering a full circular area and a plate supported freestanding vertical mast bearing on a reinforced concrete foundation.
 - 1. Maximum rotation: 360 degrees.
 - 2. Crane shall be designed for minimum effort manual rotation.

3. Boom shall not drift when at rest.
 4. Maximum deflection at boom end: $L/150$.
 5. Crane Operating Temperature: 5 to 200 degrees F (-15 to 93 C)
 6. Crane structural design to be based on live load capacity plus 15 percent for hoist and trolley weight and 25 percent for impact.
- B. Crane shall be designed to withstand:
1. Crane and hoist dead load.
 2. Live load capacity equal to net rated hook load:
 - a. One 2 Ton jib crane at the influent pump station
 - b. One 2 Ton and one 3 Ton jib cranes at the effluent pump station.
 3. Inertia forces from crane and load movement.
 4. Wind load: 120 MPH.
 5. Seismic loads for Seismic Design Category C.

1.4 SUBMITTALS

- A. Provide in accordance with Section 01350 – Project Document Tracking and control system:
1. Product data for crane, and accessories. Describe capacities, performance, operation, and applied forces to supporting foundation.
 2. Shop drawings showing crane configuration, dimensions, electrical wiring diagrams, and construction and installation details.
 3. Copy of warranty required by Paragraph 1.6 for review by Engineer.
 4. Manufacturer's installation instructions.
 5. Manufacturer's operation and maintenance manual.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in designing and manufacturing cranes with an ISO 9001:2015 registration and 25 years successful experience.
- B. Installer: Company experienced in assembly and installation of cranes with 5 years successful experience and acceptable to crane manufacturer.
- C. Crane shall be designed, fabricated, and installed in accordance with ANSI B30.11 and OSHA 1910.179.
- D. Base crane structural design on live load capacity plus 15 percent for hoist and trolley weight and 25 percent for impact.
- E. Perform welding by certified operators in accordance with AWS D1.1.
- F. Bolted connections shall be in accordance with torque tightening procedures specified in AISC Manual, Part 5.

- G. Clearly label crane with rated load capacity. Place label at height and location easily read from floor level and loading position.
- H. Perform OSHA Load Test Certification.

1.6 WARRANTY

- A. Provide under provisions of Section 01780 – Asset Management Records:

Warranty covers defects in equipment material and workmanship of manual systems and equipment for ten (10) years or 20 thousand (20,000) hours, commencing on the date of shipment to the first retail purchaser. This extends to non-wearable parts only.
- B. Warranty covers two (2) years for paint and finishes for non-aluminum components.
- C. Warranty covers one (1) year for motorized systems and equipment.

1.7 CONDITIONS/DELIVERY, STORAGE AND HANDLING

- A. Project Conditions
 - 1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimal results.
 - 2. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Delivery, Storage, and Handling
 - 1. Store products in manufacturer's package until ready for installation.
 - 2. Store and dispose of solvent-based materials in accordance with requirements of local authorities.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Gorbel, Inc., P.O. Box 593, Fishers, New York 14453-0593; 800-828-0086; www.gorbel.com.
- B. Spanco, Inc., Morgantown, PA and Las Vegas, NV; 800-869-2080; www.spanco.com.
- C. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Section 01600 – General Material and Equipment Requirements.

2.2 FREE STANDING JIB CRANE

- A. Type: Free standing base plate mounted, manually operated, steel jib crane with rotating boom, tagline festoon system, and other accessories:

Influent Pump Station:

- 1. Model No. FS300 (as manufactured by Gorbels, Inc.) or Model Number 100-Series Jib (as manufactured by Spanco) 2 Ton capacity, 20 feet boom span, 15 feet boom height.

Effluent Pump Station:

- 2. Model No. FS300 (as manufactured by Gorbels, Inc.) or Model Number 100-Series Jib (as manufactured by Spanco) 2 Ton capacity, 25 feet boom span, 20 feet boom height.
- 3. Model No. FS300 (as manufactured by Gorbels, Inc.) or Model Number 100-Series Jib (as manufactured by Spanco) 3 Ton capacity, 20 feet boom span, 15 feet boom height.

- B. Construction: Fabricate from ASTM A36 steel sections with finished ends and surfaces.

- 1. Boom: Horizontal, adjustable, wide flange steel beam designed for motorized hoist trolley travelling on bottom flange. Reinforce with cap channel as required for lateral stability. Equip boom with stops to limit movement of trolley.

2.3 ACCESSORIES

- A. Tagline festoon system: Provide system of wire rope tagline, [S-hooks] [wire rope trolleys], and brackets and eyebolts for attachment to boom. System shall support electrical cable supplying motorized trolley and hoist moving along boom.

2.4 SHOP FINISHING

- A. Steam wash steel crane components with iron phosphate solution and apply yellow baked enamel finish.
- B. Provide spray can of matching color, air-drying paint for field touch-up.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate provision of crane with:
 - 1. Design and construction of reinforced concrete foundation supporting vertical mast as detailed on Drawings and specified in other sections. Ensure that accurate crane applied forces and bolt patterns are provided for structural support design.
 - 2. Design and provision of electrical supply, conduit, wiring, disconnect switch, and other electrical components for powering motorized electrically operated hoist.

- B. Prior to installation:
 - 1. Verify supporting concrete foundation is ready to receive free standing jib crane.
 - 2. Verify type and location of power supply.
 - 3. Inventory parts. Verify all required components are available and undamaged.

3.2 INSTALLATION

- A. Install crane and accessories in accordance with manufacturer's instructions and shop drawings.
- B. Do not modify crane components in any manner without advance, written approval by crane manufacturer.
- C. Clearances for moving crane components:
 - 1. 3 inches minimum vertical clearance from any overhead obstruction.
 - 2. 2 inches minimum horizontal clearance from any lateral obstruction.
- D. Tighten mounting bolts to manufacturer recommended torque ratings.
- E. Lower pivot assembly: Bolt to boom web.
- F. Lift boom into place and support on temporary structure.
- G. Attach lower and then upper pivot assemblies. Tighten nuts until lock washers are compressed.
- H. Level boom and then tighten nuts on tie rod to required torque. Grease pivot assemblies.
- I. End stops: In conjunction with hoist trolley installation, bolt end stops to boom ends.
- J. Install tagline to boom with brackets and tension wire rope with eyebolts. Run festoon cable through wire rope trolleys for connection to hoist.

3.3 FIELD QUALITY CONTROL

- A. Move boom through entire travel to ensure boom is clear of obstructions, rotates freely, and does not drift. Verify motorized trolley and hoist operation, controls, and limit switches function properly.
- B. Inspect installed crane. Verify all bolts are tight and lock washers fully compressed. Verify boom is level.
- C. Adjust as required and correct deficiencies.

- D. Clean surfaces. If necessary, touch-up paint damage, scratches, and blemishes with manufacturer provided matching paint.
- E. Protect cranes from other construction operations.

3.4 DEMONSTRATING AND TRAINING

- A. Provide demonstration and training session for Owner's representative covering operation and maintenance of free standing jib crane.

END OF SECTION

SECTION 14310

MOTORIZED TROLLEYS AND HOISTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install hoist systems complete and operational.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before hoist systems Work.

C. Related Sections:

1. Section 00520, Structural Steel.
2. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/AGMA 6013-A, Standard for Industrial Enclosed Gear Drives.
2. ANSI MH 27.1, Specifications for Underhung Cranes and Monorail Systems.
3. AISC Specification for Structural Steel Buildings.
4. ASME B30.16, Overhead Hoists (Underhung).
5. ASME HST-1, Performance Standard for Electric Chain Hoists.
6. ASME HST-2, Performance Standard For Hand Chain Manually Operated Chain Hoists.
7. ASME HST-4, Performance Standard for Overhead Electric Wire Rope Hoists.
8. AWS D1.1, Structural Welding Code – Steel.
9. AWS D14.1, Specification for Welding of Industrial and Mill Cranes and other Material Handling Equipment.
10. NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Minimum of five years of experience producing substantially similar equipment and able to provide documentation of at least five installations in satisfactory operation for at least five years in the United States.
 - b. Equipment shall be manufactured in the United States.
 - 2. Installer Qualifications:
 - a. Engage an experienced installer to perform the Work under this Section, who is experienced in installing hoisting equipment similar to that required for the Project and is acceptable to hoisting equipment manufacturer.
 - b. Submit name and qualifications, and the following information for at least three successful, completed projects:
 - 1) Names and telephone numbers of each owner and architect or engineer responsible for project.
 - 2) Approximate contract cost of hoisting equipment.
 - 3) Number of installations.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of component manufacturer, from single hoisting equipment manufacturer.
 - 2. Hoisting equipment manufacturer shall review and approve or prepare all submittals for components furnished under this Section.
 - 3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall equipment assembly by hoisting equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Complete description of materials and equipment in sufficient detail to allow comparison with requirements of this Section.
 - b. Drawing showing arrangement of system and clearances, including plan and sections.
 - c. Specialized wiring diagrams, if applicable.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications identification of materials of construction, rated capacities, dimensions of individual components, and finishes.
 - b. Make, model, weight and horsepower of each component.
 - c. External power requirements for each component.
 - 3. Testing Plans: Plan for load testing at the Site.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Manufacturer's installation certification.

2. Manufacturer's Instructions:
 - a. Special shipping, storage and protection, and handling instructions.
 - b. Routine maintenance requirements prior to start-up.
 3. Field Quality Control Submittals:
 - a. Load test report, including copy of certifications of test weights.
 4. Manufacturer's Reports: Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.
 5. Qualifications Statements:
 - a. Manufacturer, when qualifications are requested by ENGINEER.
 - b. Installer, when qualifications are requested by ENGINEER.
- C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
 - a. Furnish operation and maintenance manuals in accordance with Section 01800, Maintenance.
 - b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
 2. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to materials or equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
 3. Conform to Section 01610, Transportation and Handling.
- B. Storage and Protection:
1. Keep materials and equipment off ground using pallets, platforms, or other supports. Protect steel, packaged materials, motors, and electronics from corrosion and deterioration.
 2. Conform to Section 01610, Transportation and Handling.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to and run concurrent with other

warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by provisions of specified special warranty

B. Special Warranty on Materials and Equipment:

1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct or, at option of OWNER, remove and replace, materials and equipment specified in this Section found to be defective during period of 1 year after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:

1. Hoists shall conform to headroom, hook elevation, and side clearance requirements shown and indicated in the Contract Documents and shall provide required available lift height and capacity.
2. Electrical equipment and controls shall be rated NEMA 4X.

B. Performance Criteria:

1. Electrically-operated Hoists and Motorized Trolleys:

Designation:	Hoist 1	Hoist 2	Hoist 3	
General Location:	Influent PS	Effluent PS	Effluent PS	
Hoist Type:	Chain Hoist	Chain Hoist	Chain Hoist	
Ambient Conditions (deg F, Indoor/Outdoor):	Outdoor	Outdoor	Outdoor	
Number Required:	1	1	1	
Capacity (tons):	2	2	3	
Required Lift (feet):	50	20	20	
Max Required Hook Elevation:	2ft below boom beam	2ft below boom beam	3ft below boom beam	
Lift Speed (fpm):	14	14	16	
Hoist Horsepower:	2.4	2.4	4.7	
Trolley Type:	Motorized	Motorized	Motorized	
Trolley Speed (fpm):	40	40	40	
Trolley Horsepower:	0.54	0.54	0.5	
Volts:	460	460	460	
Phase:	3	3	3	
Frequency (Hertz):	60	60	60	
Control:	Pendant	Pendant	Pendant	
Electrification:	Festoon	Festoon	Festoon	

2.2 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
 - 1. Harrington.
 - 2. Reliable, by Stanspec, a division of American Crane & Hoist Corp.
 - 3. Or equal.

2.3 DETAILS OF CONSTRUCTION

- A. Electric-powered Chain Hoists:
 - 1. Comply with ASME B30.16 and ASME HST-1. Welding shall comply with AWS D14.1.
 - 2. Design Stresses: Provide load bearing components so that stresses at rated load shall not exceed 20 percent of average ultimate strength of material.
 - 3. Hooks: Provide latch-type hooks that are free to rotate through 360 degrees under all loading conditions. Hooks shall be heat-treated drop forged steel.
 - 4. Hoisting Chain: Hardened alloy steel.
 - 5. Lift Wheel: Machined and heat treated alloy steel with hardened steel chain guides.
 - 6. Gearing: Machined and heat treated helical gear system. Hoist gearbox shall be in accordance with AGMA 6013-A. Provide means for adequate lubrication of gearing.
 - 7. Bearings: Bearings shall be permanently lubricated type.
 - 8. Hoist Brakes: Provide hoist with two brakes: motor brake and load brake. Each brake shall be capable of supporting and holding 125 percent of full rated load without electrical power.
 - 9. Provide overload protection device that prevents lifting of loads beyond rated capacity.
 - 10. Motor: Motor shall be specifically constructed for reversing and hoisting service and capable of operating at specified loads. Motor shall be heavy-duty, thermally protected, 30-minute rated, H4 duty cycle, with Class F insulation. At rated frequency, motor shall be capable of operating at plus ten percent of rated motor voltage.
 - 11. Hoist shall contain upper and lower adjustable limit switches.
 - 12. Housing and Covers: Cast aluminum.
 - 13. Provide supports, fasteners, brackets, chain container, and all accessories required.
- B. Electric-powered Trolleys:
 - 1. Trolley shall be constructed to accept the specified hoist using lug-mounted suspension and shall be of sufficient size and strength to transport rated load of the associated hoist.

2. Trolley frame shall have steel side plates that wrap around trolley to provide protective lug to prevent trolley from falling off monorail in event of wheel axle failure.
3. Wheels: Wheels shall be fabricated of (--1--) and shall be constructed to run on specified beam. Wheels shall have uniform surface hardness and capable of carrying maximum applied load.
4. Trolley motor shall be (--2--) thermally protected, with Class B insulation.
5. Gearing: Machined and heat treated spur gear system. Gearbox shall be in accordance with AGMA 6013-A. Provide means for adequate lubrication of gearing.
6. Bearings: Bearings shall be ball or roller type, permanently lubricated.

2.4 CONTROLS FOR ELECTRIC HOIST AND TROLLEY

A. Hoist Speed Control:

1. Hoist motor shall be single-speed or dual-speed, as specified in Article 2.1 of this Section, with magnetic control.
2. Each magnetic control shall have contactors sized for specified class of service. Reversing contactors shall be mechanically and electrically interlocked to prevent line-to-line faults, and shall be provided with automatic reset thermal overloads for hoist motor.

B. Control Station:

1. Control station shall be rated in accordance with Paragraph 2.1.A of this Section. Motion control pushbuttons shall spring return to “Off” position when released. Function of each pushbutton shall be clearly marked and indicate direction of resultant motion.
 - a. For two-speed hoists, control station shall contain the following functions:
 - 1) “POWER ON”
 - 2) “POWER OFF”
 - 3) “HOIST UP - HI”
 - 4) “HOIST DOWN - HI”
 - 5) “HOIST UP - LO”
 - 6) “HOIST DOWN - LO”
 - 7) “TROLLEY – FORWARD”
 - 8) “TROLLEY – REVERSE”
 - b. For single-speed hoists, control station shall contain the following functions:
 - 1) “POWER ON”
 - 2) “POWER OFF”
 - 3) “HOIST UP”
 - 4) “HOIST DOWN”
 - 5) “TROLLEY – FORWARD”
 - 6) “TROLLEY – REVERSE”

2. Pendant Control:
 - a. When specified in Article 2.1 of this Section, control of hoist and trolley shall be by pendant pushbutton control station.
 - b. Pendant mounting shall include steel cable to provide strain relief for pendant's electric control cable. Provide isolating transformer to reduce voltage to 120 volts (or less) in control circuits.
 - c. Mount control pendant and cable on 12-gage stainless steel C-track festoon system that allows hoist and trolley to move independently of control station.
3. Infrared Remote Control:
 - a. Where specified in Article 2.1 of this Section, control of hoist and trolley shall be by infrared remote control station.
 - b. System shall allow for separate programmable security codes to eliminate interference from other infrared signals.
4. Radio Remote Control:
 - a. Where specified in Article 2.1 of this Section, control of hoist and trolley shall be by radio remote control station.
 - b. System shall allow for separate programmable security codes to eliminate interference from other radio signals.

2.5 ELECTRIFICATION

- A. Eight-bar Conductor:
 1. When specified in Article 2.1 of this Section, provide enclosed rigid type contact conductor system mounted parallel to crane runway or track. Conductors shall comply with NEC Article 610. Contact conductors shall be sized to carry required current to all motors when operating at rated conditions. Collectors shall be shoe-type and be constructed to reduce to a minimum sparking between shoe and contact conductor.
 2. System Components: Electrification system shall include the following:
 - a. Conductor bars.
 - b. Hanger clamps for conductor bars.
 - c. Power feeds to conductor bars.
 - d. End caps for conductor bars.
 - e. Torsion spring collectors.
 - f. Special tooling to install electrification system.
 - g. Cable and connectors for power and control connections.
- B. C-Track Festoon:
 1. Provide power cable on 12-gage stainless steel C-track festoon system.
 2. System Components: Electrification system shall include, but not limited to, the following:
 - a. C-track

- b. Track hangers.
- c. Cable carriers.
- d. Lead carrier.
- e. End stop.
- f. Splices.
- g. Clamps.
- h. Cable and connectors required for power and control connections.

2.6 FINISHING

- A. Surface Preparation and Painting:
 - 1. Surface preparation and shop painting is required for ferrous metals, equipment, and accessories. Do not paint stainless steel and machined surfaces.
 - 2. Clean and apply in the shop prime coat in accordance with Section 09 91 00, Painting.
 - 3. Apply manufacturer's standard factory finish.
- B. Gears, bearing surfaces, and other machined surfaces shall receive a heavy application of rust-inhibiting coating that shall be maintained during storage and until equipment is placed into operation.

2.7 IDENTIFICATION

- A. Identify component subassemblies with stainless steel nameplates and each labeled with the following:
 - 1. Manufacturer and model number.
 - 2. Date of manufacture with pertinent ratings, operation, and maintenance information.
 - 3. Certification, stamp, or approval to applicable Laws and Regulations.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
- B. Inspect and verify that no part of the building, structure, piping, mechanical systems including ductwork, electrical systems including lighting and conduit, or other elements that will interfere with proper operation of hoist along the entire length of monorail track.

3.2 INSTALLATION

- A. Install materials and equipment in conformance with Laws and Regulations, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents.
- B. Refer to Section 05120, Structural Steel, for requirements for hoisting system's supporting steel.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. After installing equipment and associated controls, perform at the Site running tests for hoisting equipment and appurtenances. Should testing indicate malfunction, make repairs and adjustments as required. Repeat testing and adjusting until, in ENGINEER's opinion, installation is complete and equipment is functioning properly and accurately, and is Substantially Complete.
 - 2. Load Test:
 - a. Perform load tests under supervision of manufacturer's factory-trained service technician, in presence of ENGINEER.
 - b. Weights used in load testing shall be certified by a state or local bureau of weights and measures. Submit weight certification as part of the load test report.
 - c. Load testing shall conform to ASME B30.11, ASME B30.16, and the following:
 - 1) For electric hoists, power failure test with rated load: Load shall be held suspended when power is removed.
 - 2) Trolley travel full length of monorail with rated load, while verifying that all functions operate properly.
 - 3) Hoist brake drift test with rated load: Lift weight, measure distance to floor, allow five minutes to elapse, and re-measure. Record the results measured. Criteria for Acceptance: No difference in measurements.
 - 4) Upper/lower limit switch test with no load.
 - 5) Emergency stop test with no load.
 - d. Load Test Report: Submit results of load testing as report that lists tests performed, data collected, results of each test, and corrective actions taken (if any). Test report shall be signed by manufacturer's service technician present during testing.
- B. Manufacturer's Services: Provide a qualified, factory-trained service technician to perform the following:
 - 1. Instruct CONTRACTOR in installing equipment and assist in the installation of equipment.

2. Inspect and adjust equipment after installation and ensure proper operation and supervise initial operations and load tests.
3. Instruct OWNER's personnel in operating and maintaining the equipment.
4. Manufacturer's technician shall make a minimum of 3 visits, with minimum number of hours on-Site for each visit as specified.
 - a. First visit shall be for instructing CONTRACTOR in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 2 hours.
 - b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Minimum number of hours on-Site: 3 hours.
 - c. Third visit shall be to instruct operations and maintenance personnel. Number of hours on-Site shall be in accordance with Section 01800, Maintenance.
 - d. Technician shall revisit the Site as often as necessary until installation is acceptable.
5. Manufacturer's Installation Certification: Submit certification that manufacturer's technician has checked completed installation and equipment, as specified in the Contract Documents, has been provided in accordance with manufacturer's recommendations, and that operation of equipment is satisfactory. Certification shall be signed by manufacturer's technician present at the Site and CONTRACTOR.
6. Training: Furnish services of Supplier's qualified factory trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01800, Maintenance.
7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

END OF SECTION

SECTION 14620

SCREW BULK MATERIAL CONVEYORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install screw bulk material conveyor systems and associated control panel complete and operational in accordance with the Contract Documents.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that will be installed with or before screw bulk material conveyor Work.

C. Related Sections:

1. Section 01610, Transportation and Handling
2. Section 01664, Training
3. Section 03055, Concrete
4. Section 05051, Anchor Systems.
5. Section 05120, Structural Steel
6. Section 09900, Painting.
7. Section 11113, Bar Screens
8. Division 16, Electrical
9. Section 17000, Instrumentation, Control and Monitoring System General Requirements.
10. Section 17260, Process Control Panels and Hardware.
11. Section 17275, Miscellaneous Panel Instruments.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. American Bearing Manufacturers Association (ABMA), ABMA STD 11, Load Ratings and Fatigue Life for Roller Bearings.
2. ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
3. ASTM A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
4. 4 ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.

5. ASTM A269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
6. ASTM A276, Specification for Stainless Steel Bars and Shapes.
7. ASTM A351/A351M, Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
8. ASTM A403/A403M, Specification for Wrought Austenitic Stainless Steel Piping Fittings.
9. ASTM A666, Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
10. ASTM D4020, Specification for Ultra-High-Molecular-Weight (UHMW) Polyethylene Molding and Extrusion Materials.
11. AWS D1.1/D1.1M, Structural Welding Code-Steel.
12. Conveyor Equipment Manufacturers' Association (CEMA), CEMA 300, Screw Conveyor Dimensional Standards.
13. CEMA 350, Screw Conveyors for Bulk Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment to that specified in this Section and shall be able to document at least five installations in satisfactory operation for at least five years.
2. Welding Qualifications: Equipment manufacturer's shop welds and welding procedures and personnel shall be qualified and certified in accordance with AWS D1.1/D1.1M.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of component manufacturer from a single screw bulk material conveyor manufacturer.
2. The equipment manufacturer shall prepare, or review and approve all Shop Drawings and other submittals for components furnished under this Section.
3. Components shall be specifically constructed for specified service conditions and be integrated into overall assembly by screw bulk material conveyor equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings: Submit the following:
 - a. Manufacturer's literature, illustrations, specifications, and engineering data including: materials, dimensions, weights, performance data, and part lists for all components in sufficient detail to allow an item by item comparison with the Contract Documents.

- b. Drawings and information for control panels and instruments per Division 17. This includes submittal of panel wiring drawings, hardware, circuit breakers, motor starters, and electrical devices furnished.
 - c. Motor test reports for furnished motors or for a previously manufactured electrically duplicate motor that was tested, including running light current, locked rotor current, winding resistance measurement, high potential test, bearing inspection, and efficiency at 1/2, 3/4, and full load.
 - d. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - e. List of deviations from the Contract Documents.
 - f. Listing of conveyor components and materials.
 - g. Provide a copy of the manufacturer's standard warranty for parts and labor.
2. Test Procedures: Submit and obtain ENGINEER's approval of test procedures for shop test and field operating tests prior to performing tests.

B. Informational Submittals: Submit the following

- 1. Certificates:
 - a. Welding certifications.
- 2. Source Quality Control Submittals: Written reports of shop tests, submitted prior to shipment from factory.
- 3. Field Quality Control Submittals: Written reports of operating tests and other field quality control tests required.
- 4. Manufacturer's Instructions: Submit manufacturer's instructions and recommendations for:
 - a. Storage.
 - b. Handling.
 - c. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
 - d. Installation.
- 5. Manufacturer's Reports: Submit a written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed and results obtained.
- 6. Qualifications Data:
 - a. Manufacturer, when requested by ENGINEER.
 - b. Welders.

C. Closeout Submittals: Submit the following:

- 1. Operation and Maintenance Data:
 - a. Submit complete operation and maintenance manuals, including copies of test reports, maintenance data, and schedules, description of operation, and spare parts information.

- b. Furnish operation and maintenance manuals per Section 01800, Maintenance.
- 2. Tools and Spare Parts: Provide tools and spare parts as specified in this .

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.
 - 2. Comply with Section 01610, Transportation and Handling.
- B. Storage and Protection:
 - 1. Protect steel, packaged materials, and electronics from corrosion and deterioration.
 - 2. Comply with Section 01600, General Material and Equipment Requirements.

1.6 MAINTENANCE

- A. Special Tools: Furnish two sets of special tools required for normal operation and maintenance of products furnished.
- B. Extra Materials:
 - 1. Furnish the following spare parts for each screw conveyor provided under the Contract:
 - a. Two sets of each type of packing and seal provided.
 - b. One set of trough liners (provided flat).
 - c. One year's supply of lubricants required for the conveyor, drive, and bearings.
 - 2. Furnish the following spare parts for the Contract:
 - a. One spare drive for each different horsepower drive supplied.
 - b. One spare gear reducer for each type and size of gear reducer supplied.
 - c. Two spare covers of standard length, complete with gaskets and clips.
 - d. One-year supply of lubricants required for conveyors, drives, and bearings.
 - e. Two spare motion sensors.
 - 3. Furnish and deliver spare parts carefully packed in sturdy containers with clear indelible identification markings. Store spare parts as recommended by manufacturer until transferred to OWNER.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Description:

1. Provide shaftless screw direct-driven conveyor system without intermediate bearings to convey the material specified in a totally enclosed and lined trough. Conveyor system shall be constructed to operate in forward and reverse directions, with screws operating together and independently to convey material. Screw bulk material conveyors shall comply with CEMA 300 and CEMA 350, as applicable.
2. System Description: Screw bulk material conveyor is to convey material from the two (2) Bar Screen discharge ports to the outload facilities, with a single discharge port per screw bulk material conveyor in the dumpster bay, together with feed hoppers, discharge chutes, screw conveyor local control station, and appurtenances.
3. Shafted-type screw bulk material conveyors are unacceptable.

B. Service Conditions:

Parameter	Service Condition
Designation	SC 4.0
Location	Screening Building
Number of Screw Conveyors	1
Number of Diverter Gates per Screw Conveyor	0
Number of Drive Motors per Screw Conveyor	1
Number of Discharge Ports per Screw Conveyor	1
Number of Inlet Ports per Screw Conveyor	2
Conveyed Material	Screened Solids
Maximum Loading Capacity, cu. Ft./hr.	150
Maximum Solids Content of Conveyed Material	20%
Density of Conveyed Material, lbs/cu ft.	62.4
Maximum Trough Fill	25%
Spiral Diameter, in.	11
Spiral Pitch, in.	13
Minimum Trough Width, in.	12
Inclination*, degrees	2
Approximate Screw Conveyor Length*, ft.	20

Motor Horsepower	1.5
Conveyor Motor Voltage/Phase/Hertz	460/3/60
Screw Speed, RPM	19
Screw Direction Capability	Reversible
Direction of Drive (Push/Pull)	Push

* Data provided is approximate and subject to change with CONTRACTOR's final layout. Field-verify required length and inclination and submit final design with Shop Drawings. No extra compensation will be paid for minor revisions to screw conveyor length and inclination required. Extra compensation will not be paid for changes required for CONTRACTOR substitutions or alternatives awarded.

2.2 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
1. Spirac, Inc.
 2. JDV Equipment Corporation.
 3. Parkson Corporation
 4. Biosec Enviro, Inc.
 5. Schwing BioSet, Inc.
 6. Or equal.

2.3 DETAILS OF CONSTRUCTION

- A. General
1. Screw bulk material conveyor drive unit shall be designed for 100 percent of rated capacity and be capable of starting screw conveyor with a completely full trough.
 2. Screw bulk material conveyor shall be designed and constructed for conveying material with minimal maintenance. Design spiral flights to be self guiding and aligning in trough. Guide bearings are not allowed.
 3. Prior to fabricating screw conveyor, determine requirements for and furnish brackets, chutes, and hardware required for a complete system.
 4. Conveyor Materials:
 - a. Plate and Shapes: Type 316L stainless steel.
 - b. Inlet and Outlet Ports: Locations as shown, ASTM A167, 3/16-inch thick Type 316L stainless steel. Dimensions by manufacturer.
 - c. Spiral Flights: Cold-formed spring steel with a minimum Brinell hardness of 220 HB with the ability to transmit a minimum of 32,000 inch-pounds of input torque.
 - d. End- and Drive Shafts: Heat-treated alloy steel AISI, Grade 4150, of uniform diameter.

- e. Wear Liner: 3/8-inch minimum thickness ultra high molecular weight (UHMW) polyethylene, per ASTM D4020. Attached to trough with Type 316L stainless steel clips, 3/8-inch minimum thickness installed as required by manufacturer. Liner shall be sintered with an antiwear filler to reduce wear and a synthetic lubricant to reduce friction. The liner shall be provided with a visual, two-color indicator of excessive wear. Wear liner bars are not acceptable.
- f. Fasteners for Conveyor Supports: ASTM A193/A193M, Type 316L stainless steel.
- g. Fasteners in Contact with Conveyed Material: ASTM A193/A193M, Type 316L stainless steel.
- h. Gaskets: Neoprene, 50 durometer.

B. Screw Flights:

- 1. Screw flights shall be helicoids, ribbon-type. Sectional flighting formed from flat discs or plates are not acceptable.
- 2. Design screw flights with the stability to prevent distortion and jumping in trough.
- 3. Splice connections between spirals shall be full penetration welds. Field welds of spiral sections, when required, shall be done in strict accordance with manufacturer's requirements.
- 4. Pitch of flights shall be constant over entire length of screw conveyor.
- 5. As its torsional rating, the stress in the screw flighting shall not exceed 30 percent of F_y value in extreme fiber of flight material.
- 6. Brake Horsepower: Produce less torque than rating of screw flighting.
- 7. At 250 percent torque of motor nameplate horsepower rating, drive train shall not produce more torque than screw flighting's torsional rating.
- 8. Spiral edges shall be smooth in as-rolled condition and not show grinding marks.
- 9. "Spring effect" of screw shall not exceed 0.8 percent of total spiral length.
- 10. Connection of screw to drive system shall be via a flanged connection plate welded to screw forming a smooth and continuous transformation from flange plate to screw. Drive shaft shall have a mating flange and be bolted to screw connection plate.
- 11. Do not restrain screw tail end. Tail bearing, thrust plate, or end shaft is not required. Terminate screw flights at leading edge of transition or drop at conveyor end.

C. Conveyor Trough

- 1. Screw conveyor troughs shall be U-shaped, double-flanged style.
- 2. Fabricate troughs from 3/16-inch minimum, ASTM A167, Type 316L stainless steel.

3. Roll troughs to shape with flanges formed with or welded to trough. Troughs shall be similar to dimensional standards of CEMA 300 and enclosure Classification II E.

D. Trough End Plates

1. Fabricate end plates from a single 3/8-inch thick Type 316L stainless steel plate, shaped to support bearings and drives in true alignment. Support bearings and end drive housings shall be welded to screw conveyor trough end plates or bolted to trough end plate using a matching 3/8-inch thick mounting plate. Provide trough stiffener channels as required per ASTM A276.
2. Angled Screw Bulk Material Conveyors With Tail End Supported from Floor: Fabricate tail end plate with a foot to support weight of screw conveyor.
3. Suspended Screw Bulk Material Conveyors: Fabricate end plates without foot supports.

E. Conveyor Trough Covers and Clips

1. Provide flanged covers that provide an airtight seal for portions of trough that are not covered by inlet ports.
2. Covers shall be fabricated from a minimum 12-gauge, ASTM A167, Type 316L stainless steel.
3. Individual covers shall be no greater than six feet in length each.
4. Provide a 1/16-inch thick gasket between cover and full width of trough top flange.
5. Trough covers shall be hinged and fastened by stainless steel D-rings and Military Grade hook and loop nylon straps with Velcro closures.

F. Inlet and Discharge Ports

1. Screw conveyor shall include inlet and discharge ports per the Drawings.
2. Provide a flanged, flexible connector at each port where the screw conveyor is connected to other equipment.
3. Flexible connector shall be 1/4-inch thick neoprene with integrally molded flange at each end, and include stainless steel back-up bars. Flexible connector shall be at least six inches high.
4. Flanged connections shall include a minimum 1/8-inch thick gasket and stainless steel connecting hardware for both flanges.
5. CONTRACTOR and screw bulk material conveyor manufacturer shall coordinate design of inlet and discharge ports with equipment to which they will connect. Provide flexible connectors to mate with connecting equipment.
6. Provide external, stainless steel stiffeners to prevent port deformation.

G. Conveyor Supports

1. Conveyor troughs and drives shall be supported using a minimum 1/4-inch thickness, rectangular, Type 316L stainless steel shapes and plates per ASTM A276.
2. Ratio of unbraced length to least radius of gyration shall not exceed 240 for tensile members and 120 for compression members.
3. Design to not exceed one-third of AISC allowable stresses when loaded to twice running torque of motor.
4. Support loads shall be based on trough completely filled, weight of conveyor, and dynamic loading when operating.
5. Coordinate support locations with existing facility structure. Supports shall not restrict access to other process systems.

H. Drainage Connections

1. Provide drain outlet, welded to the screw conveyor per the Drawings.

I. Drive Assembly

1. Drive assembly shall be rigidly supported so there is no visible movement under all operating conditions. Drive system shall be capable of starting screw conveyor fully loaded with material.
2. Drive Shaft, Bearings, and Seals:
 - a. Drive shaft shall include flanged ends or mating bolt holes to match screw flange connection plate.
 - b. Drive bearings shall be ABMA STD 11, high capacity roller bearings located in reducing drive housing with an L-10 life rating of 100,000 hours.
 - c. Drive bearings shall be capable of supporting thrust loads and provide angular alignment with trough.
 - d. Drive end seals shall consist of a compression packing gland between drive shaft and sleeve.
3. Stuffing Box:
 - a. Provide a stuffing box to prevent leakage of product out of conveyor.
 - b. Stuffing box shall be cast iron or galvanized steel, with nominal 1/2-inch by 1/2-inch Teflon-impregnated packing, packing ring adjustment to tighten packing onto shaft, and packing ring housing bolted to screw conveyor trough end plate. Packing glands shall incorporate a stainless steel grease fitting with lantern ring set in middle of packing rings, with at least two rings of packing on product side of lantern ring. Provide at least one ring on non-product side of lantern ring.
4. Gear Reducers
 - a. Gear reducers shall be helical and reduction based on manufacturer recommendations, and shall be mounted to the trough end plate.
 - b. Gear reducers shall be close coupled to the motor.

- c. Size gear reducers based on input power to each gear reducer, with resulting torque calculated at output shaft rpm, with a safety factor of 1.5 times this calculated torque. Nominal rated output torque (AGMA Class II) shall be greater than or equal to the calculated output torque and its safety factors.
 - d. Nominal related output torque must not exceed electric motor nameplate horsepower equivalent torque at gear reducer output shaft rpm.
 - e. Housing of speed reducer shall be 30,000 psi cast iron with removable inspection covers, oil breathers, and oil level indicators. Removal of inspection covers shall not necessitate draining of lubricating oil.
5. Electric Motor:
- a. Electric drive motors shall operate on electrical service specified in this Section under Service Conditions.
 - b. Motors shall be premium efficiency with TEFC Type II enclosure. **RATED FOR HAZARDOUS LOCATION**
 - c. Provide with 1.15 service factor and comply with latest ANSI, NEMA, and IEEE Standards.
 - d. Motors shall be air cooled. Auxiliary cooling is not acceptable.
 - e. Motor thrust bearings shall be adequate to carry continuous thrust loads under all service conditions and have a minimum B-10 life of 30,000 hours.

2.4 FABRICATION

A. Material:

- 1. Fabricate parts and assemblies specified as stainless steel from sheets and plates of Type 316L stainless steel with a 2D finish conforming to AISI Type 316L and ASTM A666, unless noted otherwise. Fabricate tubular products and fittings per ASTM A269, ASTM A351/A351M, and ASTM A403/A403M.
- 2. Bolts, nuts and washers shall be AISI Type 316L stainless steel furnished per ASTM A193/A193M and ASTM A194/A194M.
- 3. Passivate stainless steel surfaces by the following procedure:
 - a. Wire brush all weld areas to remove weld spatter. Brushes shall be Type 316L stainless steel and used only on Type 316L stainless steel.
 - b. Bead or pumice-blast all external non-wetted stainless steel to a uniform finish.

B. Welding:

- 1. Perform factory welding using shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide a cross section and weld metal equal to or greater than parent metal. Fully penetrate

- butt welds to interior surface and provide gas shielding to interior and exterior of joint.
- 2. Field welding of stainless steel is not allowed.

2.5 INSTRUMENTATION AND CONTROLS

General:

- A. A single control panel shall be provided for the two Bar Screens and Screw Conveyor . The panel will be provided by the Bar Screen manufacturer. All equipment provided by the Conveyor manufacturer shall be coordinated for proper power supply. **ALL PANELS AND DEVICES RATED FOR HAZARDOUS LOCATION**
 - 1. Provide a Local Control Panel (LCP) for each screw conveyor furnished complying with Division 17.
 - 2. The Conveyor Manufacturer shall include the following devices:
 - a. Motion sensor protection controller module.
 - b. Pull cord emergency-stop (E-stop) interlock circuitry.
 - c. "LOCAL/OFF/REMOTE" (L-O-R) selector switch.
 - d. Local "STOP" and "START" pushbuttons. Stop pushbutton shall be lockable.
 - e. Indicating lights for "RUNNING FORWARD" (green), "RUNNING REVERSE" (flashing red), and "STOP" (red). Provide contacts for each for remote monitoring.
 - f. "FORWARD/REVERSE" selector switch. Provide Forward-Reverse combination motor starter with main circuit breaker and solid state overload relays.
 - g. Indicating light for "FAIL" (amber) that will illuminate when run contact is closed and motion failure alarm is activated. Provide dry contact "MOTION FAIL" output for remote monitoring. Screw Conveyor failure alarm shall be sent to DCS indicating the conveyor is not working.
 - h. Audible horn and red flashing strobe light that will activate when the stop switch emergency cord is pulled. Provide dry contact output signal for remote monitoring if pull cord circuit is activated. Provide horn silence and reset circuitry.
- B. Motion Failure Alarm
 - 1. Provide the screw conveyor with a motion failure alarm system consisting of a non-contacting heavy-duty motion sensor installed on the screw conveyor trough body and LCP-mounted and powered motion sensor alarm circuitry. **RATED FOR HAZARDOUS LOCATION**
 - 2. Motion sensors shall not utilize magnets. Sensors shall pick up on the ferrous spiral of the screw to detect flight motion.
 - 3. Motion sensors shall detect through trough without a hole to at least three inches distance, and include phenolic body and internal pre-amp.

4. Provide stainless steel mounting bracket for sensor on trough.
 5. Motion sensor controller shall have a built-in zero to sixty second time delay, to allow monitored equipment to reach normal operating speed after a conveyor start command.
 6. Product and Manufacturer: Milltronics MFA-4P controller with MSP 12 motion sensor, or equal.
- C. Emergency Stop Switch
1. Provide the screw conveyor with an emergency pull cord and safety stop switch system. Cord shall be provided around full perimeter of screw conveyor. Pulling cord shall activate emergency stop circuit causing the screw conveyor to immediately stop.
 2. Install emergency stop switches in accordance with manufacturer's instructions.
 3. Products and Manufacturers: Provide products of one of the following:
 - a. Scientific Technologies, Inc., Model ER4020.
 - b. Conveyor Components Company, Model RS.
 - c. Or equal.

2.6 ANCHORAGE DEVICES

- A. Provide anchorages and fasteners of Type 316 stainless steel of ample size and strength for the purpose intended, sized by equipment manufacturer.
- B. Anchorage devices shall conform to Section 05051, Anchor Systems.

2.7 LUBRICANTS

- A. Provide lubricants required for initial operation. Products shall be by Lubrication Engineers and recommended by screw bulk material conveyor manufacturer.

2.8 SOURCE QUALITY CONTROL

- A. Upon completion of manufacture of screw bulk material conveyor and appurtenances, conduct manufacturer's standard shop tests prior to shipment. Shop tests shall be conducted using the products to be provided for the Project, including job motors and screws to be provided for the Project. Multiple-piece screw conveyors shall be tack-welded together for testing.
- B. At a minimum, each screw bulk material conveyor shall be operated in the shop in forward and reverse (if applicable) modes for a minimum of five minutes of continuous operation at proposed design operating speed and direction. Equipment shall operate in a satisfactory manner without mechanical defects, excessive vibration and noise, and operational irregularities.

- C. All defects or defective equipment revealed by, or noted, during tests shall be corrected or replaced promptly and products retested until satisfactory results are achieved.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install products in conformance with governing codes, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents.
- B. Anchorages and Baseplates:
 - 1. Provide anchorages in new or existing concrete, as applicable, per equipment manufacturer's recommendations and the Contract Documents. Equipment manufacturer shall supply templates to facilitate location of anchorages for equipment. CONTRACTOR shall coordinate with the Supplier and equipment manufacturer to assure timely receipt of required templates.
 - 2. Where used, pour concrete bases up to one inch below equipment baseplate or support leg as applicable. Base with equipment mounted thereon shall then be accurately shimmed to grade and spaces between filled with non-shrink grout in accordance with Section 03055, Concrete. After grout has reached its initial set, exposed edges shall be neatly cut back 1/2-inch.
- C. General:
 - 1. Perform all drilling and fitting required for installation. Set the products accurately in location, alignment, and elevation, plumb, true, and free of rack.
 - 2. Making plate cutouts or openings in the field is not allowed.
 - 3. Fit exposed connections accurately together to form tight hairline joints.
 - 4. Secure plates to supporting members or frames with zinc or cadmium coated machine screws for steel and stainless steel screws for aluminum and stainless steel. Place screws not more than three inches from each plate section end and not more than 24 inches on centers, unless otherwise shown.

5. For contact surfaces between aluminum and dissimilar surfaces, use a coat of bituminous paint or other approved insulating material.
6. Provide utility connections per the Contract Documents. Verify that utilities are tested and operational before placing equipment into operation.
7. Align and adjust equipment including shafting, motors, belts, drives, chutes, hoppers, and drains in presence of ENGINEER
8. Provide motion sensor for each equipment item, including appropriate mounting brackets, verifying and providing if required appropriate ferrous elements on the screw, coordinating location of the sensors, and installing sensors.
9. Prior to energizing electrically- or fuel-powered motor driven equipment, rotate drive motor by an external source to demonstrate free operation of all mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional.

D. Comply with Division 01, Checkout and Startup Procedures.

3.3 FIELD QUALITY CONTROL

A. Site Tests:

1. Following installation, CONTRACTOR and a qualified field service representative of equipment manufacturer shall conduct operating tests of all equipment, functions, and controls at the Site in presence of ENGINEER.
2. Field Operating Test:
 - a. Field test equipment and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part individually and all parts together function properly in manner intended. Total duration of testing shall be 24 hours, continuous and uninterrupted, in automatic mode. All testing equipment and manpower shall be by CONTRACTOR.
 - b. Should tests result in malfunction, make necessary repairs, revisions, and adjustments and restart test from the beginning. Repeat tests and repairs, revisions, and adjustments until, in opinion of ENGINEER, installation is complete and equipment is functioning properly and accurately, and is ready for permanent operation.

B. Manufacturer's Services: Provide a qualified, factory trained serviceman to perform the following:

1. Supervise unloading and installation of equipment.
2. Instruct CONTRACTOR in installing equipment.
3. Inspect and adjust equipment after installation and ensure proper operation.

4. Instruct OWNER's personnel in operating and maintaining the products.
5. Manufacturer's representative shall make a minimum of 4 visits, with a minimum of 8 hours onsite for each visit. First visit shall be for unloading supervision and instruction of CONTRACTOR in installing equipment; second visit shall be for assistance in installing equipment; third visit shall be for checking completed installation and start-up of system; fourth visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.
6. Training: Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of the products. Training requirements, duration of instruction, and other qualifications shall be per Section 01664, Training.
7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to Site shall be included in the Contract Price.

END OF SECTION

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE

- A. The work described in this Section and/or indicated on the Drawings shall include, except where otherwise noted, the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical work shown on the Drawings.
- B. Prior to the ordering or purchase of any equipment or materials or the layout or installation of any work, the Contractor shall visit and examine the site and shall examine and understand the work shown on the Drawings and described in these Specifications. If any work involves existing equipment, ductwork, piping, buildings, etc., the Contractor shall first verify model numbers, electrical characteristics, sizes, dimensions, etc. to be compatible with the work shown on the Drawings.
- C. Throughout the course of the Project, the Contractor shall schedule and coordinate work with the Engineer and other trades to optimize space utilization and avoid conflict or interference with the work of other trades, other Contractors, structural elements, doors, windows, lights, conduit and other equipment or systems.
- D. Unless otherwise shown on the Electrical Drawings, the mechanical work shall include the following items. These items shall conform with the requirements of Division 16.
 - 1. All motors, motor starters, disconnect switches, relays and other controls and control wiring necessary for the proper operation of all mechanical equipment shall be furnished and installed under Division 15. Power wiring to mechanical equipment and a 120 Volt source for control power shall be provided as a part of the electrical work.
 - 2. All controls and control wiring shall be provided and installed under Division 15. Where control power is not available in the vicinity of mechanical equipment, a transformer shall be furnished and installed to convert power voltage to control voltage. The transformer may be an integral part of the starter.
 - 3. Starters complete with "hand off automatic" switches, with running indication lights in an approved enclosure, shall be furnished and installed for mechanical equipment automatically started and stopped, or otherwise controlled by thermostats, timers, or other

devices under Division 15. Starters for all manually controlled equipment shall include start stop pushbuttons with running indication lights in an approved enclosure.

- E. All electrical item enclosures provided under Division 15 of the Specifications shall be provided in accordance with the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.
- F. The Contractor will be held responsible for the satisfactory and complete execution of all work included. The Contractor shall produce complete finished operating systems and provide all incidental items required as part of the work, regardless of whether such item is particularly specified or indicated.

1.2 QUALITY ASSURANCE

- A. Codes and Standards
 - 1. All mechanical work shall be performed in accordance with all applicable codes, ordinances, rules and regulations of local, state, federal or other authorities having jurisdiction. As a minimum, this shall include:
 - a. International Building Code, 2018 Ed. with Georgia Amendments.
 - b. International Mechanical Code, 2018 Ed. with Georgia Amendments.
 - c. International Energy Code, 2015 Ed. with Georgia Supplements and Amendments.
 - d. International Plumbing Code, 2018 Ed. with Georgia Amendments.
 - e. International Fire Code, 2018 Ed. with Georgia Amendments
 - f. 2018 NFPA 101. Life Safety Code with State Amendments.
 - g. National Electrical Code, 2020 Ed. with no Georgia Amendments
 - h. Unless otherwise specified on the Drawings, the latest edition of all codes, ordinances, etc. shall be followed. Where code or other requirements exceed the provisions shown on the Contract Documents, the Contractor shall notify the Engineer. Where provisions of the Contract Documents exceed code or other requirements, the Work shall be performed in accordance with the Contract Documents.
 - 2. All equipment, products and materials used in mechanical work shall be listed by Underwriters Laboratories, ARI or AMCA as appropriate.

3. The Contractor shall schedule all required tests and inspections with a minimum of 72 hours prior notice to the Engineer.
- B. Allowable Tolerances: Equipment shall be readily adaptable for installation and operation in the structures shown on the Drawings. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the City. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such alterations shall be made at the Contractor's expense.

1.3 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.
- B. Drawings and Specifications:
 1. The Drawings are diagrammatic and, unless specifically dimensioned, are intended to show only the general arrangement of equipment and accessories, and the general routing of piping, ductwork, etc. The Drawings do not specifically show every fitting, offset, contour, etc. required to accomplish the intended work or to avoid every interference that may be encountered. It shall be the responsibility of the Contractor to arrange all work to fit within the allowed space without modifying any building structure or property, and to make readily accessible all equipment and accessories requiring servicing or maintenance.
 2. Should any changes be deemed necessary by the Contractor in items shown on the Contract Drawings, the Contractor shall submit shop drawings, descriptions, and the reason for the proposed changes to the Engineer for approval.
 3. Exceptions and inconsistencies in Drawings and Specifications shall be brought to the Engineer's attention before Bids are submitted.
- C. Operation and Maintenance Instructions: Operation and maintenance instructions shall be provided in accordance with the requirements of the General Conditions of the Contract Documents. The Contractor shall instruct the City's personnel during the adjustment and testing period. The Contractor shall also, in the presence of the Engineer, demonstrate the complete operation of each and every piece of apparatus.

1.4 QUALITY STANDARDS

- A. All materials shall be furnished by manufacturers fully experienced, reputable and qualified in the manufacture of the particular material to be furnished. All material shall be designed, constructed and installed in accordance with standard practices and methods and shall comply with these Specifications as applicable.
- B. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

1.5 TRANSPORTATION AND DELIVERY

- A. as part of the mechanical work, the Contractor shall provide and pay for all transportation, delivery and storage required for all equipment and materials.
- B. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.6 STORAGE AND PROTECTION

- A. Equipment and materials shall be properly stored to protect against vandalism, theft, the elements and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first class operating condition shall be installed.
- B. Provide protection covers, skids, plugs or caps to protect equipment and materials stored or otherwise exposed during construction.

1.7 WARRANTY

- A. All mechanical work described in the Contract Documents shall be warranted in accordance with the General Conditions of the Contract Documents.
- B. This warranty shall apply to all equipment, materials and workmanship.
- C. During the warranty period, all defects in mechanical systems shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the City.

PART 2 - PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

A. General

1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be new, of the best grade and quality and of current production, unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.
2. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage or wear. All products and materials shall be suitable for the intended service.
3. Electric motors shall be as specified in Section 16150, Electric Motors, unless otherwise specified.

B. Piping: See appropriate sections of Division 15 for Specifications on various piping systems. See Part 3 of this Section for general stipulations on installation of piping systems.

C. Unions

Provide and install unions between each item of equipment and the valve controlling and/or the various piping connections to it.

- a. Steel and Stainless Steel Pipe: Unions 2 1/2 inches and smaller shall have ground joints. Unions 3 inches and larger shall have flanged unions.
- b. PVC Pipe: Unions 2 inches and smaller shall be threaded and have Buna O rings. Unions 2 1/2 inches and larger shall be flanged.

D. Equipment Bases: Each piece of equipment which is motor driven shall be furnished with an approved base, which shall be in addition to the foundation. Each base shall be furnished integral with the equipment or apparatus, or shall be furnished as a separate item, designed to accommodate the equipment or apparatus. Submit shop drawings for all foundations and supports for review. Consult relevant Sections in Division 11 for additional Equipment Base specifications.

E. Dielectric Isolation

1. Wherever dissimilar metals are used in piping systems, this connection shall be made with dielectric isolators. The dielectric isolators shall be so designed that nonferrous piping materials shall be isolated by the use of Teflon or nylon isolating materials made up in the form of screwed type unions or insulating gaskets and bolt sleeves and washers for standard flanged connection. All dielectric isolators shall be selected for the pressure and contents of the system involved.
2. Dielectric isolators shall be Watts, Epco, Crane, Maloney, or Equal.

- F. Anchor Bolts
 - 1. All anchor bolts shall conform to the requirements of Section 05051, Anchor Systems
 - 2. All anchor bolts are to be supplied by the manufacturer or fabricator of the specific material or equipment to be installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General
 - 1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be installed according to the manufacturer's recommendations and in accordance with the best practice and standards for the work.
 - 2. All work shall be performed by competent personnel satisfactory to the Engineer. All work requiring particular skill shall be performed by persons that have had special training and past experience in that line of work.
- B. Equipment Support
 - 1. Major equipment supports (concrete foundations, framed structural openings, etc.) shall be furnished and installed under other Divisions of the Contract Documents as shown on the Drawings. The mechanical work shall include, however, the furnishing and installation of all miscellaneous equipment supports, housekeeping pads, structural members, rods, clamps and hangers required to provide adequate support of all mechanical equipment.
 - 2. Unless otherwise shown on the Drawings, all mechanical equipment, piping and accessories shall be installed level, square and plumb.
- C. Pipe and Ductwork Penetrations
 - 1. Sleeves or wall pipes shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations when required. Existing titanium and ductile iron wall pipes shall be left in place and reused whenever possible. Sleeves for ductwork shall be 20 gauge galvanized steel. Sleeves shall be sized to provide a minimum of ¼ inch clearance between the sleeve and pipe or duct. For insulated pipes or ducts, the clearance shall be ¼-inch between the sleeve and the insulation.
 - 2. As far as possible, all pipe and ductwork penetrations shall be made at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.
- D. Welding

1. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.
 2. All welding operations shall conform to the latest recommendations of the American Welding Society or to the applicable provisions of the Code for Pressure Piping. The Contractor shall pay for all electrical energy and/or gas used in welding.
- E. Cutting and Patching: Where cutting or patching becomes necessary to permit the installation of any work or should it become necessary to repair any defects that may appear in patching, the Contractor shall make the necessary repair at no cost to the City.
- F. Large Apparatus and Equipment: All large apparatus and equipment which is specified or shown to be furnished or installed under this Contract, and which may be too large to be moved into its final position through the normal building openings planned, shall be placed by the Contractor in its approximate final position before any obstructing structure is installed. All apparatus shall be cribbed up from the floor and cared for as specified under Paragraph 1.6 or as directed by the Engineer.
- G. Cross Connection and Interconnections
1. No plumbing fixture, device or piping shall be installed which will provide a cross connection or interconnection between a distributing supply for drinking or domestic purposes and a polluted supply, such as drainage system or a soil or waste pipe which will permit or make possible the backflow of sewage, polluted water, process chemicals, or waste into the water supply system.
 2. The Contractor shall verify location of all existing utilities and make all connections to existing facilities as required.
- H. Thermal Expansion of Piping
1. The Contractor shall furnish and install all devices required to permit the expansion and contraction of all work installed by the Contractor, particularly in water supply and chemical systems. In the main water and chemical lines, Contractor shall employ expansion joints where required or directed by the Engineer. Swing joints, turns, expansion loops or long offsets shall be provided wherever shown on the Drawings or wherever necessary to allow for the expansion of piping within the building. Broken pipes or fittings broken due to rigid connections must be removed and replaced at the Contractor's expense.
 2. Anchor all lines having expansion joints so that expansion and contraction effect is equally distributed. Verify exact locations of anchors with the Engineer prior to making installation. The lines having expansion joints shall be accurately guided on both sides of

each joint. These guides shall consist of saddles and "U" clamps properly arranged and supported. Submit complete details for approval.

3. In installing expansion members, exercise care to preserve proper pitch on lines. Furnish and install all special fittings, connectors, etc., as required.

3.2 SURFACE PREPARATION, SHOP AND FIELD PAINTING

- A. Unless otherwise specified herein or shown on the Drawings, general painting of mechanical equipment shall be in accordance with Section 09900, Painting.
- B. Touch up painting of mechanical equipment shall be part of the mechanical work. All equipment and materials that are painted or coated by the manufacturer shall be touched up prior to completion to conceal any and all scratches or other finish irregularities and to maintain the integrity of the paint or coating. All painting and coating shall match the original and shall conform to the requirements detailed in other sections of these specifications.
- C. All roof mounted equipment shall be painted with an exterior paint of a type and color as specified in Section 09900, Painting. The painting shall not impair the performance of the equipment in any manner.

3.3 INSPECTION AND TESTING

- A. The mechanical work shall include all materials and labor required to properly test and balance all mechanical systems as required by codes and as described herein.
- B. Concealed, underground and insulated piping shall be tested in place before concealing, burying or covering. Tests shall be conducted in the presence of the Engineer or designated representative. Equipment, materials and instruments required for tests shall be furnished without incurring additions to the Contract. The Contractor shall schedule all required tests and inspections with a minimum of 72 hours prior notice to the Engineer.
- C. Unless otherwise specified herein, all mechanical piping shall be tested as required by Code to 1 1/2 times the rated system pressure or 100 psig, whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.
- D. Soil, waste and vent piping shall be tested with water before installing fixtures. Water test shall be applied to the system either in its entirety or

in sections. If the test is applied to the entire system, all openings in the piping shall be closed except to highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening except the highest opening of the section under test shall be plugged and each section shall be filled with water and tested with at least a 10-foot head of water. Each joint or pipe in the building except the uppermost 10 feet of the system shall be submitted to a test with at least a 10-foot head of water. The water shall be kept in the system, or in the portion under test, for at least 1 hour before the inspection starts; no substantial drop in the water level will be acceptable.

- E. The services of an independent testing and balancing agency shall be used to balance the air and water distribution systems.

3.4 CLEANING

- A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the site.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.
- C. All air moving equipment operated during construction shall have filters in place and changed regularly so as to be clean.
- D. After testing and balancing and just prior to Engineer review and acceptance, all systems shall be finally cleaned and shall be left ready for use. Air filters shall be new and piping strainers shall be clean.

+++ END OF SECTION +++

SECTION 15056

PIPE SUPPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Design, and provide a complete system of pipe supports with inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, sliding Teflon plates, and accessories as indicated and specified. The term pipe support includes hangers, guides, restraints, anchors and saddles.
- B. Provide all support systems and the design of all support systems for all piping as specified herein. The Contractor shall provide pipe support locations, configurations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein.
- C. The Contractor shall be responsible for the proper design, fabrication, location, shop drawings and installation of all pipe supports in accordance with the specified requirements.
- D. Pipe support locations and types for piping ½ in. and larger shall be determined by the Contractor using the guidelines for support spacing specified herein and other criteria contained in this pipe support specification. Guidelines for pipe supports may need to be adjusted based upon field coordination, field routing, or other considerations outlined herein such as structural load limits. The Contractor may revise the pipe support locations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein. The Contractor is responsible for the proper design, installation and fabrication of all pipe supports in accordance with the specified requirements. For supports for pipe ½ in. and larger, provide shop drawings together with a marked up piping drawing showing support number, location and typical type shall be submitted by the Contractor for acceptance.
- E. The Contractor shall be responsible for coordinating all pipe support designs for all trades to ensure compliance with all of the requirements of this specification, including but not limited to the total limitations specified in paragraph 2.3 F.
- F. Design and provide all temporary pipe supports required during installation and testing.

1.2 RELATED WORK

- A. Division 1: General Requirements
- B. Section 033055: Concrete
- C. Section 09900: Painting
- D. Section 15060: Piping and Appurtenances
- E. Section 15100: Valves and Appurtenances

1.3 REFERENCES

- A. American Institute of Steel Construction (AISC) Manual of Steel Construction.
- B. American Society for Testing and Materials (ASTM) Publications:
 - 1. A36: Specification for Structural Steel.
 - 2. A500: Cold formed welded and seamless carbon steel structural tubing.
 - 3. E165: Practice for Liquid Penetrant Inspection Method.
 - 4. E709: Practice for Magnetic Particle Examination.
 - 5. A307: Specification for Carbon Steel Bolts and studs, 60,000 psi Tensile.
 - 6. A312: Seamless and welded austenitic stainless steel pipe.
 - 7. A572: Specification for Steel Plate.
- C. American National Standards Institute (ANSI):
- D. ASME/ANSI B31.1: Power Piping Code.
- E. American Welding Society (AWS) Code:
- F. Structural Welding Code D1.1.
- G. Manufacturers' Standardization Society (MSS):
 - 1. MSS SP-58: Pipe Hangers and Supports - Materials and Design.
 - 2. MSS SP-69: Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.
 - 4. MSS SP-90: Guidelines on Terminology for Pipe Hangers and Supports
- H. National Association of Expansion Joint Manufacturers: Standards of the Expansion Joint Manufacturers Association, Inc.
- I. OSHA

1.4 SEISMIC DESIGN REQUIREMENTS

- A. Conform to the requirements as indicated on the structural drawings and as specified herein.
- B. It shall be the responsibility of the Contractor to conform to the seismic design requirements for this project and for the work of this specification section.
- C. Provide all pipe supports designed in accordance with the seismic requirements indicated and specified.
- D. Additionally, provide with the Certificate of Design, certification signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

1.5 SUBMITTALS

Shop Drawings: Submit the following in accordance with the General Conditions:

- A. Pipe support drawings specified in paragraph 1.01 and including data for accessory items for acceptance prior to fabrication. The Contractor shall submit pipe support coordination drawings including all piping and pipe supports for all trades.
 - 1. Detailed drawing of the device with dimensions.
 - 2. A table of applied forces and moments.
 - 3. A complete bill of materials.
 - 4. A unique identification and revision level.
 - 5. Stamp of a Registered Professional Engineer, registered in the State of Georgia, experienced in pipe support design and pipe stress analysis as specified in paragraph 1.6 D.
 - 6. Detailed connections to existing structure.
 - 7. Indicate all welds, both shop and field, by Standard Units of Measurement as specified in AWS D1.1-1.7.
- B. Welding Procedure: Submit description as required to illustrate each welding procedure to be performed in the specified work.
- C. Welding Equipment: Submit descriptive data for welding equipment, including type, voltage and amperage.
- D. Qualification for Welders: Provide certification that welders to be employed in work have satisfactorily passed AWS or ASME qualification tests. If recertification of welders is required, retesting is the Contractor's responsibility at no additional cost to the Owner.

- E. Pipe support manufacturers' qualifications as specified in paragraph 1.6 D.
 - 1. List of at least five (5) successful pipe support projects and current addresses and telephone numbers of persons in charge of representing the owner or the owner of those construction projects during the time of pipe support design, fabrication and installation.
 - 2. Qualification of manufacturers' Registered Professional Engineer, registered in the state where this project is being constructed, whom stamps and seals shop drawings and designs.
- F. Coordination drawings for pipe supports shall include as a minimum the following information.
 - 1. Coordination drawings shall include all pipe supports covered by Section 15060.
 - 2. These coordination drawings will be used by the Contractor to ensure that the pipe supports do not obstruct access, access for equipment operation or removal including all mechanical and electrical equipment, panels, valves, gauges, and instrumentation.
 - 3. The Contractor shall be responsible for including and coordinating the work of all subcontractors into the coordination drawings.
 - 4. Prepare reproducible coordination drawings, indicating equipment, piping, valves, expansion joints, ductwork, conduit, cable trays, junction boxes, lighting fixtures, sleeves, inserts, embedments, supports, hangers and appurtenances at not less than 1/4 inch scale. Drawings shall show beams, columns, ceiling heights, wall, floors, partitions and structural features as indicated on the contract drawings. Individual pipes and conduit 2-in. or less in diameter that will be field routed need not be shown on coordination drawings.
 - 5. Coordination drawings shall include large-scale details as well as cross and longitudinal sections as required to fully delineate all conditions. Particular attention shall be given to the location, size, and clearance dimensions of equipment items, shafts, operators and necessary maintenance access.
 - 6. Make all minor changes in duct, pipe or conduit routings that do not affect the intended function, but items may not be resized or exposed items relocated without the approval of the Owner. No changes shall be made in any wall locations, ceiling heights, door swings or locations, window or other openings or other features affecting the function or aesthetic effect of the building. If conflicts or interferences cannot be resolved, the Owner shall be notified. Any problems of coordination that require architectural or structural changes of design shall be submitted to the Owner for resolution.
 - 7. After the reproducible drawings have been coordinated and all changes have been made, the drawings shall be signed by the Contractor and all subcontractors indicating that all work on that

drawing has been coordinated with all associated vendors and subcontractors and all conflicts have been resolved.

8. Relocation of any duct, pipe, conduit or other material that has been installed without proper coordination among all trades shall be performed at no additional cost to the Owner.

- G. Written notification of any deviations from the requirements of this specification.
- H. Support documentation and justification as specified.
- I. Certificates of Design signed by a Registered Professional Engineer for all pipe supports.

1.6 QUALITY ASSURANCE

- A. Pipe supports: All supports and parts shall conform to the latest requirements of the Code for Pressure Piping ASME/ANSI B31.1 and Manufactures Standardization Society (MSS) Standard Practice SP-58, SP-69, SP-89 and SP-90 except as supplemented or modified by the requirements of this specification.
- B. Structural Concrete: Conform to the requirements of Section 03055 for Class D concrete unless noted otherwise.
- C. Conform to the requirements of the latest edition of the AISC Manual of Steel Construction for miscellaneous and supplementary steel. Tube steels are ASTM A500 Grade B, structural shapes A36, plates A-572 or equal. Stainless steel structural members shall conform to ASTM requirement Type 316L.
- D. Pipe Support Manufacturer Qualifications:
 1. Must possess a written quality assurance program.
 2. Have a minimum of 5 years experience in the design and fabrication of pipe supports.
 3. Have completed the design and fabrication of at least 5 successful pipe support projects of equal size, complexity, and systems as this project within the past 10 years.
 4. Retains the services of a Registered Professional Engineer, registered in the state where this project is being constructed, with a minimum of ten years experience in the design of piping systems and pipe supports.
 5. Manufacturers' Standardization Society (MSS) Member.
 6. Have a field service technician on staff with at least 5 years experience in resolving field installation, interference and interface problems associated with the design, installation and manufacture of pipe supporting components. Hanger inspections shall be performed in accordance with MSS-SP-89 and ASME B31.1.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Shipping:
Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
- B. Receiving:
 - 1. Inspection and inventory items upon delivery to site.
 - 2. Store and safeguard material in accordance with manufacturers' written instructions.

1.8 SPECIAL REQUIREMENTS

Refer to applicable specification sections of Division 1 and provide the following.

- A. Foundations, Installations and Grouting.
- B. Bolts, Anchor Bolts, and Nuts.
- C. Sleeves and inserts.
- D. Protection against electrolysis.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Carpenter & Paterson.
- B. Grinnell Corporation.
- C. Basic Engineers Inc.
- D. Or equal.

2.2 MATERIALS:

- A. Allowable materials: As indicated in ANSI B31.1 Appendix A and MSS-SP-58 Table 2.
- B. Provide Type 316L stainless steel for all exterior or interior pipe supports, hangers, guides, restraints, and anchors that are not otherwise specified.
- C. Supports, hangers, guides, and restraints in contact with corrosive chemicals or in chemical containment areas shall be pultruded FRP of premium grade vinyl ester resin. FRP fabrications shall comply with recommended practices of the American Composites Manufacturers

Association. Fire resistance of FRP fabrications shall meet or exceed the requirements for Class 1 flame rating of 25 or less when tested in accordance with ASTM E84 and self-extinguishing requirements of ASTM of ASTM D635. Color of products shall be yellow.

- D. Provide only new material. Previously used and/or scrap material is not acceptable.
- E. Provide tube steels that are ASTM A500 Grade B, Structural shapes A-36, plates A-572 or equal.
- F. Provide sliding Teflon plates as required. The sliding surfaces shall be a nominal 3/8 in. glass filled Teflon bonded to stainless steel backup plate with a 10 gauge minimum thickness. The bearing pad upper and lower units shall be as follows: Conslide Type CSA elements as manufactured by Con-Serv. Inc., Balco TFE Slide Bearing Plates 10N-cs as manufactured by Balco Inc., or Dynalon Slide Bearings as manufactured by JVI, Inc. or acceptable equivalent product .
 - 1. The blended TFE material used for this bearing shall be composed of virgin (unreprocessed) TFE resin tested per ASTM D1457 and reinforcing agents milled glass fibers. This structural material shall have the following representative mechanical and physical properties:
 - 2. Tensile strength - 2,000. psi
 - 3. Elongation - 225%
 - 4. Specific Gravity - 2.17 to 2.22
 - 5. The coefficient of friction shall average 0.06 under compressive load of 2,000 psi.
 - 6. The compressive creep shall be a minimum of 2% at 2,000 psi and 70 degrees F.
 - 7. The elements shall be flat, clean and prepared for installation in the structure. Slots and holes shall be fabricated in the bearing manufacturer's plant.
- G. Stainless Steel concrete anchor bolts per Section 05051, Anchor Systems.
- H. Provide Titanium anchor bolts for supports in contact with corrosive chemicals including chemical containment areas.

2.3 DESIGN, LOCATION, AND TYPE OF PIPE SUPPORTS

- A. Design and provide pipe supports for piping ½ in. and larger to include the following loads:
 - 1. Gravity Force: This force includes the weight of pipe, pipe contents (hydro load as required), valves, in-line equipment, insulation and any other weight imposed on the piping and/or pipe support.

2. Thermal Expansion Force: This force is developed by the restraint of free end displacement of the piping due to thermal growth.
 3. Hydrostatic/Dynamic Forces: These forces are developed due to the internal pressure (positive and negative) during operation of the piping system. These forces include the forces due to water hammer, pressure pulses due to rapid valve closure, fluid discharge resulting from pump startup, operation of positive displacement pumps, etc.
- B. Provide supports, guides, anchors, flexible couplings and expansion joints in accordance with the coupling and joint manufacturers' specifications and requirements.
- C. Where possible, provide pipe supports, which are the manufacturers' standard products.
1. Provide pipe supports with individual means of adjustment for alignment.
 2. Furnish pipe supports complete with appurtenances including locking and adjusting nuts.
 3. Hanger rods shall be subjected to tension only.
 4. Where lateral or axial pipe movement occurs, provide hangers for the necessary swing without exceeding 4 degrees. Provide base supports designed using pipe slides. The bearing surfaces: 0.06 coefficient of friction or less.
 5. Provide concrete inserts capable of supporting the design loads.
 6. Metal framing systems will be acceptable to support piping 2 in. and smaller.
 7. Provide insulated piping supported using rigid load bearing insulation (baton board type) with 16 gauge shields to fit between the insulation and the support. Shields to encompass a minimum 1/3 of the pipe circumference and be 12 in. in length.
 8. Provide load-bearing insulation capable of supporting the load, as a minimum on the bottom 60 degrees of the pipe support. Cope insulation and adjust to avoid interference of steel structures.
 9. Provide supplementary steel as needed.
 10. Do not support pipes from other pipe, conduits or stairs.
 11. Chain, strap, T-bar, perforated bar and/or wire hangers are not acceptable.
 12. Contact between piping and dissimilar metals such as hangers, building structural work or equipment subject to galvanic action is not acceptable.
 13. All pipe supports located in fluid flow shall be supplied with double nutting.
- D. Provide thrust anchors to resist thrust where required. Wall pipes may be used as thrust anchors if so designed. Welded attachments shall be of

material comparable to that of the piping, and designed in accordance with governing codes.

- E. Provide expansion joints where indicated and where required based on Contractor's design of the pipe support system. Indicate expansion joints on submittal drawings.
- F. Pipe supports connected to structural framing and slabs are subject to the following limitations:
 - 1. Less than 100 lb horizontal load per support.
 - 2. Vertical loads not to exceed an average of 25 P.S.F. for slabs, with a maximum vertical load per hanger of 1000 lbs.
 - 3. For a maximum of one pipe support per foot of slab width perpendicular to the span.
 - 4. Vertical loads not to exceed 3,000 lbs. per column or 3,000 lbs. per support at walls.
 - 5. Piping not supported from floors by metal framing must meet the limitations as specified above.
- G. All outside above ground supports shall be Type 316L stainless steel as specified in paragraph 2.2(C).
- H. Provide pipe supports that do not overload or over stress the piping, equipment, or structure that they are supporting or to which they are attached. Allowable pipe stress to be within ANSI B31.1 code allowable.
- I. The Contractor shall provide the services of a field service technician (preferably from the pipe support manufacturer) to field coordinate the locations of supports and resolve interferences and conflicts encountered during installation.

2.4 FABRICATION

- A. Provide pipe supports formed in accordance with paragraph 5.1 of MSS-SP-58.
- B. Providing welding in accordance with Structural Welding Code.
- C. Provide dimensional tolerances as specified in MSS-SP-89.
- D. Provide threading and tapping in accordance with MSS-SP-89.

2.5 SHOP PAINTING

- A. Primer and Finish Paint: Shop apply to all ferrous surfaces. Refer to Section 09900 for coating requirements.
 - 1. Color: As specified for piping system of same service or as selected by the Engineer.

2. Provide similar additional paint for touch-up after installation.
- B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions.
- C. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install items in accordance with manufacturers' printed instructions and as indicated and specified herein.
- B. Perform welding in accordance with Structural Welding Code:
 1. Visually inspect welding while the operators are making the welds and again after the work is completed in accordance with AWS D1.1 Section 6.0. After the welding is completed, hand or power wire brush welds, and clean them before the Qualified Inspector makes the check inspection. The Qualified Inspector shall inspect welds with magnifiers under light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat and concavity. The Qualified Inspector shall inspect the preparation of groove welds for throat opening and for snug positioning for back-up bars.
 2. Nondestructive evaluation of welds connecting structural steel members subjected to critical stresses: Perform in accordance with the weld quality and standards of acceptance in AWS D1.1.
 3. Magnetic Particle Inspection: Perform in accordance with ASTM E 709.
 4. Liquid Penetrant Inspection: Perform in accordance with ASTM E 165.
 5. For weld areas containing defects exceeding the standards of acceptance in accordance with AWS D1.1, Section 3.7. Provide additional testing of the repaired area at no additional cost to the Owner.
 6. Correct any deficiencies detected as directed by the Engineer at no additional cost to the Owner.
- C. Proceed with the installation of the pipe supports only after required building structural work has been completed and concrete support structure has reached its 28-day compressive strength as specified in Section 03055.

- D. Install pipe supports to comply with MSS-SP-89. Group parallel runs of horizontal piping to be supported together on trapeze type hangers.
- E. Install pipe supports to provide indicated pipe slopes. Do not exceed maximum pipe deflection allowed by ANSI B31.1.
- F. For exposed continuous pipe runs, install pipe supports of same type and style as installed for adjacent similar piping.
- G. Install pipe supports to allow controlled movement of piping systems. Permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Piping to be free to move when it expands or contracts except where fixed anchors are indicated or as required by the Contractor's pipe support systems. Where hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 in/ 100 ft, for each 100 deg. F change in temperature exceed ½ in., provide sliding supports.
- I. Prevent contact between dissimilar metals. Where concrete or metal support is used, place 1/8 in. thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and pipe support.
- J. Prevent electrolysis in support of copper tubing by use of pipe supports which are plastic coated. Electrician's tape is not an acceptable isolation method.
- K. Apply an anti-seize compound to nuts and bolts on all pipe supports.
- L. Locate reinforcing steel in concrete structure with x-ray prior to drilling for embedment plates and anchor bolts. Avoid contact or interference with reinforcing steel.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

- A. Support piping from structural framing, unless otherwise indicated.
- B. Concrete Inserts:
 - 1. Use existing embedded concrete items whenever possible.
 - 2. Use expansion anchors only when existing embedded attachment points are not available or unsuitable. Attach to hardened concrete or completed masonry.

3.3 THRUST ANCHORS AND GUIDES

- A. Thrust Anchors:
 - 1. Center thrust anchors between expansion joints and between elbows and expansion joints for suspended piping. Anchors must hold pipe rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.
 - 2. Restraining rod size and number shall be as indicated and adhere to manufacturers recommendations as a minimum.
- B. Pipe guides: Provide adjacent to sliding expansion joints in accordance with recommendations of the National Association of Expansion Joint Manufacturers and the specific joint manufacturer.

3.4 PIPE SUPPORTS

- A. Where piping of various sizes is to be supported together, space supports for the largest pipe size and install intermediate supports for smaller diameter pipes.
- B. Provide minimum of two pipe supports for each pipe piece unless approved by Engineer.
- C. Where pipe connects to equipment, support pipe independently from the equipment. Do not use equipment to support piping.
- D. Provide pipe supports so that there is no interference with maintenance or removal of equipment.
- E. Unless otherwise indicated or authorized by the Engineer, place piping running parallel to walls approximately 1-1/2 in. out from face of wall and at least 3 in. below ceiling.
- F. Pedestal pipe supports: adjustable with stanchion, saddle, and anchoring flange. Provide grout between baseplate and floor.
- G. Piping supports for vertical piping passing through floor sleeves: use stainless steel riser clamps.
- H. Support piping to prevent strain on valves, fittings, and equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise indicated. Do not install pipe supports in equipment access areas or bridge crane runs.
- I. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.

- J. Do not support piping from other piping.
- K. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized whenever possible.
- L. All rigid rod hangers shall provide a means of vertical adjustment after erection.
- M. Where the piping system is subjected to shock loads, such as disturbances due to pump discharge or thrust due to actuation of safety valves, hanger design shall include provisions for rigid restraints or shock absorbing devices.
- N. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated suitable linkage shall be provided to permit rod swing.
- O. Hanger spacing shall not exceed the spacing listed below:
 - 1. In the case of concentrated loads the supports shall be placed as close as possible to the load to reduce the bending stress.
 - 2. Where changes in direction of the piping system occur between supports, the total length between supports shall be kept to less than three-fourths of the full span. When practical, a support shall be placed immediately adjacent to any change in direction of the piping system.
- P. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamp shear lugs. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes. If friction is relied upon to support riser piping proper justification and documentation shall be submitted to ensure that enough friction force is provided to resist the applied loading.
- Q. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.
- R. All threads shall be UNC unless otherwise specified.
- S. TFE slide bearing plates with stainless steel backup plates shall be stitch weld attachments to the structure. A 1/8 in. fillet weld, 1/2 in. long every 3 inches on center each side of an element, shall be used unless otherwise indicated or specified by the manufacturers' written recommendations. Bearing elements with slots or holes shall be stitch welded in place for location. The TFE surfaces of the bearings shall be maintained clean and free from grit, dirt or grease.

3.5 INSULATED PIPING

- A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.
- B. Where vapor barriers are indicated on water piping, install coated protective shields.

END OF SECTION

SECTION 15060

PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this Section includes furnishing all labor, equipment and materials required to furnish, install and test, complete the plant piping including all fittings, sleeves, unions and accessories, as specified herein and/or shown on the Drawings. The materials to be used for piping systems are listed by service in the Piping Schedule hereinafter.
- B. Contract drawings show only functional feature and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any specific material. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the material being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.
- C. Related work specified elsewhere:
 - 1. Section 02200, Earthwork.
 - 2. Section 09900, Painting.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Manufacturer's certification.
 - 2. Manufacturer's data.
 - 3. Drawings and engineering data on fabricated piping including locations of all piping supports, anchors, expansion joints, mechanical couplings and all other piping appurtenances.
- B. Prior to its incorporation into the work, the Contractor shall submit to the Engineer written evidence that the pipe furnished under this Specification is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require

that the Contractor furnish test results from an independent testing laboratory on samples of pipe materials.

1.3 QUALITY ASSURANCE

Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. American National Standards Institute (ANSI).
- B. American Society for Testing Materials (ASTM).
- C. American Welding Society (AWS).

1.4 QUALITY STANDARDS

- A. All such work shall be done by competent workmen in a thorough workmanlike manner according to the best practice and in compliance with all codes and applicable regulations, with proper provisions for uncoupling, draining, expansion and contraction.
- B. See applicable sections of Part 2 - Products for Manufacturer quality standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.
- B. Storage
 - 1. All piping and tubing and accessories shall be stored fully supported so as not to bend or deflect excessively under their own weight. Piping shall be stored with slope so as to be free draining.
 - 2. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
- C. Handling:
 - 1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
 - 2. Avoid unnecessary handling of pipe.
 - 3. Keep pipe interiors free from dirt and foreign matter.

4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

1.6 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: No broken, cracked, deformed, imperfectly coated or otherwise damage or defective pipe or fittings shall be used. All such materials shall be removed from the site
- B. Polyvinyl Chloride Pipe and Fittings
 1. Polyvinyl Chloride Pipe shall be of unplasticized compounds suitable for use with chemicals and sewage, as shown on the Drawings and as specified and shall bear the seal of approval to this effect from an accredited testing laboratory. Pipe shall conform to the requirements of ASTM D1784 and D1785, Schedule 80, Type 1, Grade 1, or class 12454-B.
 2. Fittings shall conform to the requirements of ASTM Designation D2467, Class 12454-B for socket type and ASTM Designation D2464 for threaded type.
 3. Compounds for pipe and fittings shall conform to the requirements of ASTM Designation D1784, Class 12454-B.
 4. Joints shall be the solvent-welded socket or flanged type.
 - a. For socket weld, use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564. Application shall be in accordance with manufacturer's recommendations.
 - b. Flanges, where shown, shall be 150-pound, and shall be of the same material as the pipe. Provide with backup flanges minimum 1/8-inch thick. Backup flanges shall be Type 316 stainless steel.
 5. Bolts for use with PVC flanges shall be Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.
 6. Gaskets shall be EPDM or Viton and compatible with the process fluid, full-faced, and 1/8-inch thick, minimum. For all NaOCl applications, gaskets shall be Viton.

7. All socket connections shall be joined with PVC solvent cement conforming to ASTM D2564. Manufacturer and viscosity shall be as recommended by the pipe and fitting manufacturer to assure compatibility. Provide adequate ventilation when working with pipe joint solvent cement.
8. Provide magnetic tracer tape for all buried PVC piping.

C. Ductile Iron Pipe

1. Unless otherwise specified elsewhere, ductile iron pipe shall have a minimum wall thickness in accordance with Pressure Class 350, except for sizes 14 inches and larger, which shall have a minimum wall thickness in accordance with Pressure Class 250. All ductile iron pipe supplied shall conform to the requirements of ANSI/AWWA Specifications C150/A21.50-81 and C151/A21.51-1981.
2. Fittings in pipe lines shall conform to the requirements of ANSI/AWWA C110/A21.10-82, Pressure Class 350 for 12 inch and smaller and Pressure Class 250 for 14 inch and larger sizes.
3. Grooved end fittings shall be ductile iron and conform to the requirements or ANSI A21.10/AWWA C110 for center-to-end dimensions, and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness. Grooved ends shall conform to AWWA C606.
4. Exposed joints shall be as indicated on the Drawings. Buried joints shall be push-on or mechanical joints and shall conform to the following requirements:

Joint Types	Standard Requirements
Flanged	ANSI/AWWA C110 & ANSI B16.1, faced and drilled 125-pound ANSI Standard
Mechanical Joint	ANSI/AWWA C110, ANSI/AWWA C111 and ANSI/AWWA C151
Push-On	ANSI/AWWA C110, ANSI/AWWA C111 and ANSI/AWWA C151, American Cast Iron Pipe Company, or U.S. Pipe and Foundry Tyton joint, or equal
Grooved End	ANSI/AWWA C606

Restraining of joints shall be as recommended in AWWA M41 – Ductile Iron Pipe and Fittings.

5. Mechanical joints with retainer glands are not acceptable.
6. Flanges shall be ductile iron, threaded, rated for 250 psi working pressure, and conform to ANSI A21.15/AWWA C115 and ANSI 125 pound drilling.
7. For Class 125 FF flanges, carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts shall be used. For mechanical joints, the manufacturer's standard shall be used.
8. Gaskets for mechanical or push on joints shall be rubber, conforming to ANSI A21.11, AWWA C111. Gaskets for flanged joints shall be 1/8 inch thick, cloth inserted rubber conforming to applicable parts of ANSI B16.21 and AWWA C207. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in sewage or potable water lines. Gaskets shall be full face type for 125 pound FF flanges.

D. Copper and Copper Alloy Pipe, Tubing, and Fittings

1. Copper tubing shall be seamless, and conform to, ASTM B88 (Type K and L)
2. Fittings shall be commercially pure wrought copper, socket joint, and conforming to ASTM B75 and ANSI B16.22.
3. The solder used shall be 95 5 wire solder conforming to ASTM B32, Grade 95 TA. Do not use cored solder.
4. Piping fabrication and installation shall conform to the requirements of Chapter V of ANSI B3 1.3.
5. Bends in soft temper tubing shall be long sweep, wherever possible. Bends shall be shaped with bending tools and shall be made without appreciable flattening, buckling, or thinning of the tube wall at any point. Tubing shall be cut square and burrs removed. Inside of fittings and outside of tubing shall be cleaned with steel wool and muriatic acid before sweating. Take care to prevent annealing of fittings and hard drawn tubing when making connections. The qualification of brazing procedures, brazers, and brazing operators shall be in accordance with the requirements of Articles XII and XIII, Section IX, ASME Boiler and Pressure Vessel Code.
6. Buried service air type K copper piping shall be encased in concrete and concrete O.D. shall be 6-inches greater than pipe O.D.

E. Insulating Flanges, Couplings and Unions. Materials and ratings shall be in accordance with the applicable piping system as listed by service in the Piping Schedule. Dielectric flanges and unions shall be as distributed by Epco Sales, Inc., of Cleveland, OH; Capitol Insulation Unions; or equal. Insulating couplings shall be Dresser STAB-39; R. H. Baker Series 216; or equal.

F. Couplings

1. Flexible couplings, flanged coupling adapters, or expansion joints shall be provided for piping systems where shown on the Drawings.

The Contractor may install additional flexible couplings to facilitate piping installation, provided that it submits complete details describing location, pipe supports, and hydraulic thrust protection.

2. Acceptable types of couplings for ductile iron pipe are as follows:
 - a. Flexible Couplings: Dresser Style 153 or equal, with zinc plated bolts and nuts. Thrust ties shall be provided to sustain the force developed by 1 ½ times the test pressure specified.
 - b. Transition Couplings: Transition couplings used to connect pipes with small differences in outside diameter shall be Dresser Style 162, or equal.
 - c. Flanged Adapters:
 - 1) Flanged coupling adapters shall be used for joining plain end cast iron or ductile iron pipe to flanged valves, pumps and fittings. Flanged adapters shall be suitable for working pressures to 150 psig.
 - 2) Flanged coupling adapters in sizes 12 inches and smaller shall consist of an ASTM 126, Class B cast iron flanged body drilled to mate with a 125 pound cast iron flange per ANSI B16.1, a cast iron follower ring, a rubber compound, wedge section gasket, a sufficient number of track head and electroplated steel bolts to properly compress the gasket.
 - 3) Flanged coupling adapters in sizes 12 inches and larger shall consist of a high strength steel, flanged body drilled to mate with a 125 pound cast iron flange per ANSI B16.1, a high strength steel follower ring, a rubber compound, wedge section gasket, a sufficient number of track head and electroplated steel bolts to properly compress the gasket.
 - 4) Rubber gasket shall be composed of a resilient synthetic rubber compound suitable for use in wastewater containing oil and grease.
 - d. Grooved Joint Couplings: Victaulic Style 31, with Grade S, Flushseal, nitrile gasket for abrasive sludge/grit application, or equal.
3. Acceptable types of couplings for steel pipe are as follows:
 - a. Flexible Couplings: Dresser Style 38, or equal. Thrust ties shall be as specified above for ductile iron pipe couplings.
 - b. Transition Couplings: Dresser Style 162, or equal.
 - c. Flanged Coupling Adapters: Dresser Style 128, or equal. Thrust restraint shall be as specified above for ductile iron flanged coupling adapters.
 - d. Flexible Connectors (Bellows Type): Bellows type flexible connectors shall be Style 1025 (double arched) manufactured by General Rubber Corporation, South Hackensack, NJ, or equal. Connectors shall be rated for a

working pressure of 50 psi. The maximum operating temperature is 2100 F. Connectors shall be flanged. Required sizes are shown on the Drawings. For each connector, provide thrust restraint system to limit elongation and compression of the flexible connection.

4. All fittings and connections for tubing shall be Swagelok or equal.

G. Pipe Hangers and Supports:

General:

- a. Piping shall be supported, in general, as described hereinafter and as shown by the pipe support details on the Drawings. Manufacturers' catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover typical locations where standard catalog supports are inapplicable.
- b. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing supports for the piping shown on the Drawings at the spacing specified below.
- c. All submerged piping supports, guides, and fasteners shall be Type 316 stainless steel unless otherwise shown. Concrete anchors and anchor bolts shall also be Type 316 stainless steel.
- d. Where piping connects to equipment it shall be supported by a pipe support and not by the equipment.
- e. Pipe support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.

H. Building Piping:

- a. Horizontal piping shall be supported with adjustable Clevis type hangers as shown. Furnish stainless steel protection shield and oversized hangers under all insulated piping. Pipe hangers for plastic piping shall be coated with a plastic or neoprene protective cover. No metal portion of a support or hanger shall contact pipe directly.
- b. Stacked horizontal runs of piping along walls shall be supported by a stainless steel hanger bracket framing system attached with Type 316 stainless steel anchors or concrete inserts as applicable, Unistrut, Kin Line, or equal. No pipe shall be supported from the pipe above or below it.
- c. Stacked horizontal runs of piping along ceilings shall be supported by a stainless steel trapeze type framing system

- attached with Type 316 stainless steel anchors or concrete inserts as applicable, Unistrut, Kin Line, or equal. No pipe shall be supported from the pipe above or below it.
- d. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange as shown. Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation. Pads shall be Mason Industries, Inc., Korfund Korpad, or equal.
 - e. Horizontal piping runs along floor shall be supported by stainless steel or glass fiber reinforced plastic channel and shall have lateral movement restricted. Framing shall be Cooper Industries, Unistrut, or equal. Floor supports in chemical containment areas shall be glass fiber reinforced plastic.
 - f. Supports for chemical piping shall be glass fiber-reinforced plastic with a flame spread rating of 25, in accordance with ASTM E 84. All fasteners shall be manufactured from long glass fiber-reinforced polyurethane to ensure strength and corrosion resistance. All-thread rods shall be made from vinylester resin. Products shall be Aickinstrut, Unistrut, or equal.
 - g. Horizontal piping hanger support rods shall attach to steel beams with C clamps or beam clamps; to concrete with inserts, brackets or flanges fastened with flush shells; to wood not less than 2 ½ inches thick with lag screws and angle clips.
 - h. Piping supports for vertical piping passing through floor sleeves shall be stainless steel riser clamps, Grinnell Figure 261; or equal.
 - i. All hangers, rods, clamps, protective shields, metal framing support components, and hanger accessories for non-chemical service shall be stainless steel.
 - j. Fixed supports shall be fitted with rigid top strap or clamp of the same material as the support. If metal straps or clamps are used on plastic piping, they shall be coated with a plastic or neoprene protective cover.
 - k. Horizontal pipe support or hanger spacing and hanger rod sizing shall be as shown on the Drawings.
 - l. The load rating for universal concrete inserts shall not be less than that of the hanger rods they support.
 - m. When supporting ductile iron pipe, locate hanger rods at all nonrigid joints and at each change of direction.
 - n. Vertical sway bracing shall be provided where shown, or on 10 foot maximum centers.

- o. All piping shall be supported in a manner which will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown.

I. Slab, Floor, Wall, and Roof Penetrations and Closures

- 1. Unless otherwise indicated on the Drawings, openings for the passage of pipes through floors, walls, and roofs shall be formed of sleeves of standard-weight, stainless-steel pipe. The sleeves shall be of ample diameter to pass the pipe and its insulation, if any, and to permit such expansion as may occur. Sleeves shall be of sufficient length to be flush at the walls and the bottom of slabs and to project 4-in. above the finished floor surface. Threaded nipples shall not be used as sleeves.
- 2. All sleeves shall be set accurately before the concrete is placed or shall be built in accurately as the masonry is being built. Holes drilled with a suitable rotary drill will be considered in lieu of sleeves in existing walls.
- 3. All sleeves in exterior or water bearing walls shall have a center flange for water stoppage. The annular space between pipes and sleeves in exterior walls shall be watertight. The joint shall be caulked with rubber sealant, or sealed by a modular mechanical unit consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. The interconnected rubber links shall be assembled with zinc phosphate plated steel bolts and nuts and steel pressure plates under each bolt head and nut to prevent the nut from turning when the bolt is tightened. Tightening of the bolts shall cause the rubber sealing links to expand, resulting in a watertight seal between the pipe and wall sleeve opening. Closures shall be sized according to manufacturer's instructions for the size of pipes shown on the Drawings.
- 4. Pipe sleeves within chemical containment areas shall be PVC. Annular space between sleeve and carrier pipe shall be sealed with Link-Seal modular seals constructed of materials compatible with the contained fluid.

J. Flexibility:

- 1. Unless otherwise specified, piping 2 inches in diameter and larger passing from concrete to earth or from below a structure to outside of the structure shall be provided with two pipe couplings or flexible joints. The first joint shall be within 2 feet of the face of the structure. The second joint shall be located 2 feet or one pipe diameter (whichever is greater) after the first joint. Where required for resistance to pressure, mechanical couplings shall be restrained as specified elsewhere.

K. Expansion Joints:

1. Expansion joints shall be designed in accordance with Expansion Joint Manufacturer's Association (EJMA) standards for pressure, temperature and service as specified.
2. Expansion joints for plant water service shall be rubber type designed for temperatures up to 180 F and pressures up to 150 psig. Construct expansion joints of neoprene or Buna-N. Expansion joints shall be filled arch type. Provide backup or retaining rings as recommended by expansion joint manufacturer. Expansion joints shall be yoked in manner to provide transmission of tension loading to which expansion joint may be subjected during system operation. Compression or lateral movement of expansion joint shall not be impaired by yoking system. Details of expansion joint yoking shall be submitted to ENGINEER for approval. Expansion joints shall be as manufactured by Mercer Rubber Company, US Rubber Supply Company, or Equal.
3. Expansion joints/flexible couplings for Sodium Hypochlorite and Sodium Bisulfite service shall be multi-ply bellows type designed for temperatures up to 200 F and pressures up to 60 psig. Expansion joints shall allow a minimum of 1 inch of axial movement and ½ inch of misalignment. Bellows shall be constructed of PTFE (Teflon). Unless otherwise specified, end connections shall be flanged. Flanges and hardware shall be of Type 316 stainless steel construction. Expansion joints shall be as manufactured by Mercer Rubber, Flexicraft Industries, or Equal.

L. Pipe Identification

The following shall be continuously printed on the pipe or spaced at intervals not exceeding 10 feet.

1. Name and/or trademark of the pipe manufacturer.
2. Nominal pipe size.
3. Schedule number.
4. Manufacturing standard reference, e.g., ASTM F441.
5. Production code from which the date and place of manufacture can be determined.
6. Provide pipe identification labels and directional arrows on all above grade piping.

M. Protective Coating for Piping

1. Interior. Ductile iron process pipe for sludge, thickened sludge, drain line, and main thickener drain service shall receive a factory applied ceramic epoxy lined coating of Protecto 401 as manufactured by Induron Coatings Inc., Birmingham, AL, or equal, and applied at a nominal thickness of 40 mils. Ductile iron pipe for plant water shall have standard cement mortar lining.
2. Exterior. Field coat exposed piping in conformance with Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. All exposed piping shall be firmly anchored and supported by pipe supports or anchors as shown or required. Pipe supports shall be furnished as shown on the Drawings or in accordance with the requirements of this section. All pipe shall be carefully placed to the proper lines and grades as shown on the Drawings.
2. Full lengths of pipe shall be used wherever possible. Short lengths of pipe with couplings will not be permitted. Pipe shall be cut to exact measurement and shall be installed without forcing or springing.
3. Lines which slope shall have the right of way over lines whose elevations can be changed. Offsets, transitions, and changes in direction in pipes shall be made as required to maintain proper head room, slope, etc.
4. Piping shall be installed in such manner and at such times as will require a minimum of cutting and repairing of building structures. In case any such cutting or repairing is necessary, it shall be done only with the permission of the Engineer. Cutting and repairing shall be performed by craftsmen of the trade which originally executed the work, and repairs shall match the original condition.
5. All changes in direction in piping systems shall be made with suitable fittings.
6. When storing and installing pipe, care shall be taken to prevent damage to the pipe coatings. All damaged coatings shall be repaired to the satisfaction of the Engineer.
7. A liberal number of unions and/or flanged joints shall be used to permit the ready removal of any section. Unions shall be installed in all piping connections to equipment, to regulating valves, and wherever necessary to facilitate the dismantling of piping and removal of valves and other items requiring maintenance. Flanges on equipment may be considered as unions.
8. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as disconnect points if required.)
9. Installed piping shall not interfere with the operation of or accessibility to doors and/or windows, shall not encroach on aisles, passageways and equipment, and shall not interfere with the servicing or maintenance of any equipment.
10. The interior of all piping shall be free from obstructions and protrusions. All burrs shall be removed from the inside and outside

edges of all cut pipe by reaming. Cutting shall be done in such a manner so as to leave a smooth end at right angles to pipe threads. Tool marks and unnecessary pipe threads shall be avoided. Cuttings and other foreign material shall be removed from the inside of the pipe prior to installation.

11. After installation, the interior of all piping shall be cleaned as necessary to remove flux, slag, scale, rust, dirt, oil, and other foreign material. As piping is installed, open ends shall be covered or plugged as necessary to prevent the entrance of foreign matter and to maintain the required cleanliness.
12. Changes in pipe size shall be made using reducing fittings, not bushings. If centerline elevation is not specified, use eccentric reducers in horizontal piping. On liquid lines, eccentricity shall be down with top of pipe level. On vapor and gas lines, eccentricity shall be up with bottom level.
13. Indicated locations and sizes of equipment connections are approximate; exact locations and sizes of piping, valves, etc., shall conform to approved shop drawings. Connection sizes shall not be smaller than scheduled size or equipment outlet size, whichever is larger.
14. Vent and drain valves shall be inserted in all high and low points of all pipes. Sizes of vent and drain valves shall be as approved by Engineer, but at a minimum shall be 1-inch size.
15. Required straight runs of piping upstream and downstream of flow measuring devices shall be smooth.
16. Minimum pipe cover shall be 3 feet, as measured from the pipe barrel, unless otherwise indicated on the Drawings.

B. Installation of PVC Pipe and Fittings:

1. All PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Buried plastic pipe shall be laid by snaking the pipe from one side of the trench to the other. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of solvent welding and final use.
2. Use solvent welded or flanged connections where possible to connect to valves or fittings. Use Schedule 80 threaded nipple for connections to threaded valves. Avoid threaded connections when possible. All PVC to metal or PVC to FRP pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, or couplings, nor shall PVC piping be threaded into metal valves, fittings, or couplings.
3. Only strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to overtighten these fittings. Pipe shall not be laid when the temperature is below 40 degrees F, nor above 90 degrees F when exposed to direct sunlight. Ends to be

joined shall be shielded from direct sunlight prior to and during the laying operation.

C. Installation of Ductile Iron Pipe:

1. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.
2. Ends of pipe in accordance with the type of joint to be made. Dress cut ends of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket. Dress cut ends of pipe for flexible couplings and flanged coupling adapters, as recommended by the coupling or adapter manufacturer. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer.
3. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to assure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.
4. Mechanical joint, push-on, and restrained joint pipe shall be joined in accordance with the manufacturer's recommendations. Provide all special tools and devices such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes shall be permitted under any circumstances.
5. Grooved Joints: Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

D. Installation of Copper Pipe

1. For copper tubing, snake piping in trench to compensate for thermal expansion and contraction.
2. Soldered Joints:

- a. Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
 - b. Ream or file pipe to remove burrs.
 - c. Clean and polish contact surfaces of joints.
 - d. Apply flux to both male and female ends.
 - e. Insert end of tube into full depth of fitting socket.
 - f. Heat joint evenly.
 - g. Form continuous solder bead around entire circumference of joint starting at the bottom.
3. Threaded Joints:
- a. When open flames for soldering are impractical, or at unions and connections to equipment and appurtenances, assemble copper tubing with flared ends as permitted by authority having jurisdiction.
 - b. Ends of tubing shall be flared at an angle of 45 degrees with flaring tool recommended by pipe manufacturer. Flaring tool shall have same outside diameter as tube to be flared.
 - c. Tubing to be flared shall be soft temper or annealed prior to flaring.
 - d. End of tube shall be cut square and reamed to remove burrs.
 - e. Tube that is out-of-round shall be resized back to round.
 - f. Clean and polish contact surfaces of joints using an abrasive cloth.
 - g. Place flare nut over the end of tube with threads closest to end being flared.
 - h. Insert appropriate length of tube between flaring bar of flaring tool and position the yolk with flaring cone over tube end and clamp yoke in place.
 - i. Turn handle of yolk clockwise without over-tightening. Cracked or deformed tubes will be rejected.
 - j. Do not apply jointing compounds to mating surfaces of flare fitting and flared tube end before attaching flare nut to threaded connection.

E. Installation of Sanitary and Waste Drain and Vent Piping.

- 1. Set sanitary and waste drain and vent piping installed above floor slab true and plumb.
- 2. Set exposed risers as close to walls as possible.
- 3. Make roof penetrations watertight.
- 4. Extend vents at least 1 foot above roof.
- 5. Properly slope sanitary and waste drainage piping encased in concrete.
- 6. Coordinate routing of drains through steel reinforcement with affected trades.
- 7. Make changes of direction in waste piping with combination Y and 45-degree bend fittings.

8. Cleanout Fittings and Plugs:
 - a. Install where shown and where required by plumbing code.
 - b. T or Y branches or trap hubs shall be of the same material as the pipe in which they are installed.
- F. Installation of Roof Drainage Piping.
 1. Make changes of direction in horizontal roof drainage piping with 45-degree fittings.
 2. Make changes of direction in underground lines with combination Y and 45-degree bend fittings.
 3. Cleanout Fittings and Plugs:
 - a. Install where shown and where required by plumbing code.
 - b. Same material and size as pipe in which they are installed.
- G. Buried Piping System Thrust Restraint
 1. General: Thrust restraint for all buried pressure piping systems shall be accomplished by the use of restrained joints as specified hereinbefore.
 2. Buried Pressure Pipelines:
 - a. Thrust restraint shall be capable of restraining the buried pressure pipelines for pressures up to 1 ½ times the corresponding hydrostatic test pressures listed in the Piping Schedule.
 - b. Restrained joint type fittings shall be as specified hereinbefore.
 3. The Contractor shall provide restrained joints for all buried piping, except RCP, with test pressure higher than 20 psig.
- H. Pipe Dope:
 1. All threaded connections shall be made up using Teflon pipe dope applied to the male threads only.
 2. Virgin Teflon thread tape shall be Hercules Packing Company "Herculon", 3-M Company "Scotch No.48", Crane Packing Company "Teflon Thread tape", or equal.
 3. Teflon thread paste may be used in place of tape on very large or very small joints.
- I. Wall Pipes and Pipe Sleeves
 1. Wall pipes and pipe sleeves embedded in concrete walls, floors, and slabs shall be embedded as specified in Section 03055, Concrete and as shown. Support all pipes embedded in concrete walls, floors, and slabs with formwork to prevent contact with the reinforcing steel.
- J. Flexible Couplings, Flanged Coupling Adapters, and Service Saddles

Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Workmen tightening bolts shall use torque limiting wrenches.

K. Insulating Flanges, Couplings, and Unions

Install insulating flanges, couplings, or unions wherever copper and ferrous metal piping are connected, wherever submerged metallic piping is connected to unsubmerged piping, and where shown on the Drawings. Insulated joints connecting submerged piping to exposed piping shall be installed above maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive bonded concrete anchors. All submerged metallic piping shall be isolated from the concrete reinforcement.

3.2 SURFACE PREPARATION AND SHOP PAINTING

All ferrous piping not specified to be galvanized or otherwise coated shall be cleaned and shop primed or coated in accordance with the requirements of Section 09900, Painting.

3.3 FIELD PAINTING

Following installation and testing, all exposed piping, including insulated piping, shall be field primed and painted in accordance with the requirements of Section 09900, Painting. Stainless steel pipe and fittings shall not be painted.

3.4 PIPING IDENTIFICATION

A. Piping Systems. Identification of piping systems shall conform to ANSI A13.1, Scheme for the Identification of Piping Systems, unless otherwise specified herein.

B. Process Piping Code. All exposed pipe shall be identified by color and labeling to show its function. Stencil-painted labels and arrows showing the direction of flow shall be installed every 20 feet or each change of direction at each valve, and on each side of wall penetrations. Piping which is not painted shall be provided with 6-inch-wide color bands as specified. Color bands of an approved tape may be used on PVC, FRP and stainless steel pipe and other pipe which does not readily accept painted finish. The color,

banding and labeling shall conform to the schedule in Section 09900, Painting.

- C. Process Valve Identification. After the painting of process piping is complete, the Contractor shall stencil the tag numbers of all valves numbered on the Process and Instrumentation Drawings, on the pipe adjacent to the valve for pipe 2 inches and over. Characters shall be 2 inches high minimum and shall be oriented to be visible from the valve operating position. When the valve has extended operator shaft or chain operator, the number shall be placed at both the operating position and at the valve, if practicable; this requirement does not apply if the valve is buried or in a pit. Valves in pipes under 2 inches shall have characters as large as the pipe will permit or at the Engineer's option on an adjacent surface. Characters shall be preferably white; however, if this would not provide sufficient contrast to the pipe, the Engineer may select another color. Paint used shall be of the same type and quality as that used for painting the pipe.

3.5 TESTING

- A. General: Conduct pressure and leakage tests on all newly installed pipelines. Furnish all necessary equipment and material and make all taps in the pipe, as required. The Engineer will monitor the tests. Test pressures shall be as specified in the Piping Schedule.
- B. Testing New Pipe Which Connects to Existing Pipe: New pipelines which are to be connected to existing pipelines shall be tested by isolating the new Pipe.
- C. Preparation and Execution:
1. Buried Piping:
 - a. Conduct final acceptance tests on buried piping that is to be hydrostatically tested after the trench has been completely backfilled. The Contractor may, if field conditions permit, as determined by the Engineer, partially backfill the trench and leave the joints open for inspection and conduct an initial service leak test. The acceptance test shall not, however, be conducted until all backfilling has been completed.
 2. Exposed Piping: Conduct the tests on exposed piping after the piping has been completely installed, including all supports, hangers, and anchors, but prior to insulation.
 3. Hydrostatic Leak Tests:
 - a. Equipment: Furnish the following equipment for the hydrostatic tests:

Amount	Description
2	Graduated containers

2	Pressure gauges
1	Hydraulic force pump
	Suitable hose and suction pipe as required

- b. Procedure: Water shall be used as the hydrostatic test fluid unless otherwise specified. Test water shall be clean and shall be of such quality as to minimize corrosion of the materials in the piping system. Vents at all high points of the piping system shall be opened to purge air pockets while the piping system is filling. Venting during the filling of the system also may be provided by the loosening of flanges having a minimum of four bolts or by the use of equipment vents. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule. The hydrostatic test pressure shall be continuously maintained for time duration specified in pipe schedule and for such additional time as may be necessary to conduct examinations for leakage. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected at the Contractor's sole expense.

D. Buried Water and Wastewater Pressure Lines:

1. The hydrostatic testing of these pipelines must be conducted as follows:
 - a. Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least 5 days have elapsed after the thrust blocking is installed. If high early cement is used for thrust blocking, the time may be reduced to 2 days. When testing cement mortar lined piping, slowly fill the section of pipe to be tested with water and allow to stand for 24 hours under slight pressure to allow the cement mortar lining to absorb water.
 - b. Expel all air from the piping system prior to testing and apply and maintain the specified test pressure by means of the hydraulic force pump. Valve off the piping system when the test pressure is reached and conduct the pressure test for 2 hours, reopening the isolation valve only as necessary to restore the test pressure. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately. This measurement represents the leakage, which is defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period. No

pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

In the above formula:

L = Allowable leakage, in gallons per hour

N = Number of joints in the length of pipe tested

D = Nominal diameter of pipe, in inches

P = Test pressure during the leakage test, in pounds per square inch

- c. The Contractor shall correct any leakage greater than the allowance determined under this formula at the Contractor's sole expense.
2. Initial Service Leak Tests:
 - a. Equipment: Equipment used for initial service leak testing may be the same as that specified under Paragraph Hydrostatic Leak Tests hereinbefore.
 - b. Procedure: The initial service leak test shall be performed by gradually bringing the piping system up to normal operating pressure and holding it there continuously for a minimum time of 10 minutes. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected at the Contractor's sole expense.
3. Test Records: Records shall be made of each piping system installation during the test. These records shall include:
 - a. Date of test
 - b. Description and identification of piping tested
 - c. Test fluid
 - d. Test pressure
4. Remarks, to include such items as:
 - a. Leaks (type, location)
 - b. Repairs made on leaks

3.6 INTERIM CLEANING

Care shall be exercised during fabrication to prevent the accumulation of debris within piping sections. All piping shall be examined to assure removal of foreign objects prior to assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.

3.7 FINAL CLEANING

- A. Following assembly and testing and prior to final acceptance, all pipelines installed under this section, except plant process air lines and instrument air lines, shall be flushed with water and all accumulated construction debris and other foreign matter removed. Flushing velocities shall be a minimum of 2.5 feet per second. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the Engineer. Accumulated debris shall be removed through drains 2 inch and larger or by dropping spools and valves. Immediately following drainage of flushed lines, the piping shall be air dried with compressed air.
- B. Plant process air and instrument air piping shall be blown clean of loose debris with compressed air.
- C. Corrosion Protection of Piping Systems

All atmospheric exposed piping and piping components including, but not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves and fasteners shall be painted in accordance with Section 09900, Painting, as applicable to the base metal material.
- D. Pipe support systems shall be painted No. 70, light gray, as specified in ANSI Z55.1; Tnemec Co., Inc. No. 2050; or equal.
- E. Corrosion protection for buried piping systems, other than copper piping, is not required.

3.8 CORROSION PROTECTION FOR COPPER PIPING

- A. For Atmospheric Exposed Copper Pipe: Copper piping shall be painted in accordance with Section 09900.
- B. Exterior Coating for Buried Copper Pipe: All buried copper pipe shall be coated by hand taping with pipe tape. The pipe surface shall be solvent cleaned, SSPC SP 1, and wire brushed, SSPC SP 3, to remove all dirt and loose rust and mill scale, and immediately primed with the tape manufacturer's recommended primer in accordance with the manufacturer's recommendations. The tape shall be spirally applied to the pipe with a 50 percent overlap minimum after the primer has thoroughly dried. Joints shall

be tape wrapped above grade to permit joint wrapping without contamination. Pipe wrap tape and pipe wrap primer shall be as manufactured by PASCO Specialty & Mfg., Inc. or equal.

PIPE SCHEDULE							
SERVICE	FLOW STREAM ID	SIZE (IN)	MATERIAL		PIPE TESTING		
			Buried	Exposed	Type*	Test Pressure (psig)	Test Duration (hours)
Wastewater	WW	10-16	Ductile iron (cement lined)	Ductile iron (cement lined)	H	200	2
Drain (*Includes ARV discharges)	D	4 and under	PVC	PVC	H H	20 20	2 2
		6 and greater	Ductile iron (cement lined)	Ductile iron (cement lined)	H H	20 20	2 2
NOTES: *H - Hydrostatic Refer to construction drawings to identify project-specific pipe services.							

+++ END OF SECTION +++

SECTION 15100

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this Section includes furnishing all labor, materials, equipment and incidentals required to furnish, install and test all valves and appurtenances as shown and specified and as required to make the entire facility operable except for those valves and appurtenances required to be provided in other Section of these specifications. Items to be provided include but shall not be limited to the following:
 - 1. Valves.
 - 2. Operators, floor stands and valve boxes.
- B. Related Work specified elsewhere:
 - 1. Section 09900 - Painting.
 - 2. Section 15050 – Basic Mechanical Materials and Methods
 - 3. Section 15060 - Piping and Appurtenances.
 - 4. Division 17 – Instrumentation and Controls
- C. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown as specified.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

For each type and model of valve, provide:

 - 1. Assembly instructions and spare parts list.
 - 2. Preventative/corrective maintenance instructions.
 - 3. Certificate of seat compatibility with entailed fluid exposure.
 - 4. Documentation of current backflow preventer certifications.
- B. Erection Drawings. Erection drawings shall include the procedures to be used in setting, supporting, and/or anchoring the valves, the fitting of line

pipe to the valves for proper coupling, and for adjusting and testing all valve assemblies.

PART 2 - PRODUCTS

2.1 OPERATORS

- A. All valves shall be equipped with operators. The operators shall be sized based on the maximum expected torque as per valve manufacturer's recommendations. The responsibility for proper operation shall reside with valve supplier. When the maximum force required to operate a valve under full operating head exceeds 40 pounds, gear reduction operators shall be provided. Gear operators shall be totally enclosed and lubricated. All valves shall open by turning counterclockwise. Materials of construction for valve operators shall be as recommended by the manufacturer for the intended environment and service. Valves shall be installed with extension stems and valve boxes, as required.
- B. Manual Actuators:
 - 1. Multi-turn Operators: All multi-turn valves shall be fitted with handwheels of suitable size or gear operators in accordance with the manufacturer's recommendation.
 - 2. Chainwheel Operator: All Valves six feet or more above the floor level shall be provided with chainwheel operators in lieu of the handwheel operator and shall be the valve manufacturer's standard, with 316 SS chain to be furnished in the length required for operation.
 - 3. Wrench Nut Operation: An AWWA nut or shaft key, as applicable shall be provided in lieu of handwheel where required for connection to extension stem and floor stand or as indicated on the Drawings. Nut shall be constructed of cast iron. No submerged or buried operator shall require maintenance following installation. Suitable gaskets, O-rings, and other features shall insure permanent watertightness.
 - 4. Buried Service Operators:
 - a. Buried service operators on valves larger than 2- ½ inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. All moving parts of the valve and operators shall be enclosed in a housing to prevent contact with the soil.
 - b. Buried service operators for quarter-turn valves shall be designed to withstand 450 foot-pounds of input torque at the fully open or fully closed positions without damage to the valve or operator and shall be grease packed and gasketed to withstand a submersion in water to 10psi.

5. Quarter-turn Operators:
 - a. The valve operators shall be of the self-locking type to prevent the disc or plug from creeping and shall be provided with position indicators to show the position of the valve disc or plug.
 - b. Operators of the worm and gear type shall have self-locking worm gears, one-piece design, of gear bronze material, accurately machine cut. The worm shall be hardened alloy steel with thread ground and polished.
 - c. Operators of the geared traveling nut type shall have threaded steel reach rods with an internally threaded bronze or ductile nut.

C. Ball Valves:

1. Bronze ball valves up to 1-1/2-inch (incl.) in size shall have bronze 2-or 3-piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG. Metal ball valves 2-inch to 4-inch in size shall have bronze 2-or 3-piece bodies with flanged ends for a pressure rating of ANSI 125 psi or 150 psi unless otherwise indicated. The balls shall be solid chrome plated brass or bronze, or stainless steel, with full port openings. The valve stems shall be of the blow-out proof design, stainless steel, with reinforced Teflon seal. The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement. Ball valves shall be as manufactured by Conbraco Industries, Inc. (Apollo); ITT Engineered Valves; Neles-Jamesbury, Inc; NIBCO, Inc., or Equal.
2. Stainless steel ball valves up to and including 2-inches in size shall be of stainless steel construction with threaded or flanged connections. Body shall be of Type 316 stainless steel, 3-piece construction, full port opening, with slide-lock handle. Minimum working pressure shall be 250 psi. Body bolts, nuts, washers shall be 18-8 or series 300 stainless steel. Seat, seals, and stem bearing shall be PTFE. Balls and stems shall be of type 316 stainless steel. Ball valves shall be as manufactured by Jamesbury (Metso), Apollo, or Equal.

D. Eccentric Plug Valves

1. Plug valves shall be of the non-lubricated, eccentric type with resilient faced plugs, and full port area. End connections shall flanged. The body shall be of semi-steel (ASTM A-126 C1.B) and shall have bolted bonnet, which gives access to the internals of the valve. Seats shall be welded overlay of high nickel content or a stainless steel plate locked in the body cavity. If a plate is used, it shall be replaceable through the bonnet access. Plugs shall be fully encapsulated in Chloroprene. Bearings shall be Type 316L stainless

steel. Thrust bearing shall be PTFE. Bearing areas shall be isolated from the flow with grit seals. Valves shall have packing bonnets where the shaft protrudes from the grit seals. Valves shall have packing bonnets where the shaft protrudes from the valve and the packing shall be self-adjusting chevron type, which can be replaced without removing the bonnet. All nuts, bolts, springs and washers shall be Type 316 stainless steel.

2. Exterior surfaces, except finished or bearing surfaces, shall be carefully prepared by removing dirt, grease, and rust and shall be cleaned to the extent that the coating will bond to the surfaces. 12 mils minimum (non-stainless steel parts) of Blue Epoxy Tnemec 141 (NSF 61) on interior (SP5 surface prep) and 3 mils minimum (non-stainless steel parts) of Blue Enamel (NSF 61) on exterior (SP10 surface prep). The primer shall be compatible with the anticipated field coatings. Flange faces shall be protected from atmospheric corrosion.
3. Valves shall be designed for a working pressure of 150 PSI. The valve and actuator shall be capable of satisfactory operation in either direction of flow against pressure drops up to and including 150 PSI. Valves shall be bubble tight in both directions at 150-psi differential.
4. Valves 4-inches and smaller shall be provided with hand lever operators. Operators shall have heavy-duty cast iron bracket, cast iron latching lever, and self-lubricating bushings and shall be capable of securing the valve in any position.
5. Valves 6-inches and larger in diameter shall have worm gear operators. Rotary operators shall have a heavy-duty, weatherproof cast iron or steel housing with gasketed, removable cover and shall be equipped with a mechanical dial or slot type position indicator and suitable hand wheel. Manual operators shall be totally enclosed and sealed to prevent the entrance of rain, dirt, and corrosive atmospheres. Worm gear operators shall have hardened, grease-lubricated alloy steel worms and bronze worm gears. All exterior bolts and fasteners shall be stainless steel for corrosion resistance. The valve shall open with counterclockwise rotation of the hand wheel.
6. Valves located more than 6 feet above the working surface shall have a rotary operator with chainwheel. Operating nuts for buried valves shall be standard 2" square nuts and shall conform to AWWA C500. Extension stems, valve boxes, and stem guides shall be furnished as required for proper operation.
7. Plug valves are to be installed in accordance with the manufacturer's recommendations for the service conditions.
8. Manufacturers: Clow Valve Co., DeZurik Corporation, Pratt, , or Equal

E. Check Valves

1. Swing check valves for water, sewage, sludge, and general service shall be resilient-seated and of the adjustable outside lever and weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of shown in the valve schedule. They shall have a flanged cover piece to provide access to the disc. Where indicated on the drawings provide double lever and weight assemblies.
 2. Interior Coating: Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coating in accordance with AWWA C550. Min. 8 mils of NSF 61 epoxy coating inside valve.
 3. Provide valves suitable for horizontal or vertical mounting.
 4. Valve seats shall be mechanically attached and shall be field replaceable.
 5. Body: The valve body and cover shall be of cast iron conforming to ASTM A 126, with flanged ends conforming to ANSI B 16.1, or as shown in the Drawings.
 6. Disc, Cover, Gland, Disc Arm: Shall be of cast iron or ductile iron.
 7. Seats and Rings: Body seat shall be Type 316 stainless steel held in place with stainless steel set screws. Disc seat shall be Buna-N rubber and follower ring shall be stainless steel. Body seat and disc seat must be field replaceable without removing valve from the pipe. O-rings shall be Buna-N rubber.
 8. Hinge Shaft, Hinge Shaft Bushings, Shaft End Plate: Shall be of Type 316 stainless steel.
 9. Disc Center Pin Assembly: Type 316 stainless steel
 10. Internal and external bolting and other associated hardware: Type 316 stainless steel
 11. Gland Packing: Graphite and Kevlar
 12. Manufacturers: DeZurik, Crispin Valve, GA Industries, Crane, or equal.
- F. Backflow Preventer: Reduced pressure backflow preventers shall include two check valves with an independent relief between the valves, NRS isolation gate valves, three leak proof testing cocks, externally mounted strainer, and manufacturer's air gap assembly where shown on the Drawings. They shall be in accordance with AWWA C506, shall be rated 175 pounds cold water working pressure, and shall meet the requirements of USC Cross Connection Control Laboratory and ASSEE 1013. .
1. Backflow preventers shall be the reduced pressure type, providing protection during the emergency conditions of either back-siphonage or backpressure or a combination of both. Backflow preventers shall be certified by a nationally recognized testing laboratory as conforming to current requirements of ASSE 1013, AWWA C 506, or USC-FCCC. The installation shall meet all applicable state and local code.

2. Sizes $\frac{3}{4}$ -inch through 2-inches shall have bronze bodies with threaded connections, a bronze union on either side and a strainer installed upstream of the device. Gate valves shall be installed upstream and downstream of the device.
 3. Sizes $2\frac{1}{2}$ inches and larger shall be bronze with corrosion resisting moving parts and trim and flange connections. Gate valves shall be installed upstream and downstream of the device.
 4. The device shall be equipped with three (3) leak-proof test cocks. A fixed air gap, or funnel, shall be installed at the relief port. A drain line shall be piped from the discharge side of the air gap as shown on the Drawings shall be supported independently from the device.
 5. Backflow preventers shall be manufactured by Watts, Wilkins, Hersey or equal.
- G. Pressure Reducing Valves: Metallic pressure reducing valves shall be bronze body, spring controlled, adjustable pressure reducing valve with threaded connections. Provide valves with high temperature diaphragm and renewable nickel alloy seat. Provide with thermal expansion bypass. Provide with separate bronze strainer with 20 mesh 316 stainless steel basket. Attach to valve with bronze nipple. Valves shall be rated for 300 psig maximum inlet water pressure with adjustable 25-75 psig outlet water pressure. Pressure reducing valves shall be Watts 223SB or approved equal.
- H. Air Release Valves for Wastewater Service
1. General
 - a. Air release valves shall have an elongated body and be designed to operate (open) while pressurized allowing entrained air in a sludge pressure line to escape through the air release orifice without spillage or spurt. After entrained air escapes through the air release orifice, the valve orifice shall be closed by an adjustable orifice button on a compound lever mechanism to prevent media from escaping. The air release orifice shall remain closed until more air accumulates and the opening cycle repeats automatically. The air release valve shall be provided with inlet shut-off valve and blow-off valve (Type 316 SS Ball Valve), a back-flush valve with quick-disconnect coupling and flushing hose with quick-disconnect connections. Air release valves shall be as manufactured by APCO, Val-Matic, or equivalent.
 - b. Air release valves shall not admit air into the piping system to which they are attached when the internal pressure drops below the operating pressure or becomes negative gauge.
 - c. Air release valves for wastewater service shall be sewage type with elongated body and float stem. Sewage type ARVs shall be suitable for service of process fluids with 1-2% solids content.

2. Construction
 - a. Provide single body type Air release valves.
 - b. Air release valve body and cover shall be cast iron in accordance with ASTM A126, Grade B or ductile iron ASTM A536, Grade 65-45-12 or ASTM A351, Grade CF8M stainless steel. 2" through 4" valves shall have N.P.T. threaded inlets. Internal linkage, stem, and float shall be Type 316 stainless steel. Seat and other elastomers shall be Buna-N or EPDM. If valve body is not stainless steel, valve interior and exterior shall be coated with fusion bonded epoxy per AWWA C550.
 - c. Orifice size shall be manufacturer's standard size. Orifice is defined as the opening in valve mechanism through which air is expelled from pipeline or piping system.
 - d. Valve design pressure shall be 75 psig minimum.
 - e. Operating pressure range shall be 1 to 20 psig. Furnish low durometer orifice button.

I. Control Valve (Piston Type)

1. Manufacturers:
 - a. GA Industries, Inc.
 - b. Ross Valve Manufacturing Company, Inc.
 - c. Or as approved.
2. Design:
3. Basic Valve: AWWA C530 globe or angle pattern, as indicated in the Schedule, piston valve operating on the differential pressure principle, with valve piston indicator rod and flanged access cover. No diaphragm permitted. Comply with NSF/ANSI 61.
4. Service: As indicated in Schedule.
 - a. Single Acting Altitude Valve: Closes when tank side water pressure reaches the high pressure setting and opens when tank side water pressure is lower than the high pressure setting.
 - b. Double Acting Altitude Valve: Closes when tank side water pressure reaches the high pressure setting and opens when the system side water pressure is lower than the high pressure setting.
 - c. Pressure Reducing Valve: Reduces a high supply side water pressure to a lower constant demand side water pressure regardless of variations in the supply side pressure.
 - d. Pressure Sustaining/Pressure Reducing Valve: Reduces a high supply side water pressure to a lower constant demand side water pressure regardless of variations in the supply side pressure while maintaining a minimum supply side water pressure.
 - e. Surge Relief Valve: Opens when supply side water pressure exceeds high pressure setting.

- f. Pump Control: Minimize pump starting and stopping surges by opening slowly during pump start-up and closing slowly during pump shut-down with a quick close on power failure.
- 5. Body: Cast iron ASTM 126 with flanges conforming to ANSI B16.1, Class 125.
- 6. Trim: Bronze B62 and Stainless Steel ASTM A743 Grade CF-8 or CF-8M.
- 7. Seals:
- 8. Leather or other soft material. Suitable for water service.
- 9. Renewable.
- 10. Controls and Piping:
- 11. Designed for the intended service with, as applicable, solenoid valves with manual operator, adjustable speed control valves, limit switches and pilot valves.
- 12. Provide isolation valves, external strainer with flushing cock, and inlet and outlet brass bushings with gage cock.
- 13. Piping: Rigid brass piping and fittings, factory assembled and furnished with the basic valve.
- 14. Schedules:
 - a. Pressure Reducing Valve and/or Pressure Sustaining/Pressure Reducing Valve:

Location	Force Main	
Valve No.	SA 5.0	
Pattern	Angled	
Inlet Pressure Range (psi)	35	90
Outlet Adjustment Range (psi)	0	20
Initial Setting (psi)	110	
Sustained Supply Pressure (psi)	0	

2.2 PROTECTIVE COATINGS FOR VALVES

- A. Interior. Ductile iron, cast iron, and steel valves with sludge/sewage service shall receive a factory applied ceramic epoxy lined coating of Protecto 401 or equal.
- B. Exterior. Field coat exposed valves in conformance with Section 09900, Painting and as specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION

Aboveground valves shall be rigidly held in place using supports and hangers as specified. The stem orientation of valves in elevated piping shall be as approved by the Owner for accessibility, but no valve shall have stem in the downward direction. Saddle type valve supports shall be provided for all valves in vaults.

Supports shall be of rugged construction providing at least 120 degrees under-support for the valve body, shall be constructed of steel as specified in Division 5, and shall be anchored to the foundations using anchor bolts.

3.2 TESTS

Field Tests. Test all valves and appurtenances for proper operating adjustments and settings and for freedom from vibration, binding, scraping, and other defects. The testing of the hydraulically and electrically controlled valves shall be supervised by a representative of the manufacturer who shall verify proper installation, adjustments, and performance. The adequacy of all pipe hangers and supports and valve supports to meet specified requirements shall be verified. All defects found shall be corrected as approved.

3.3 COORDINATION WITH INSTRUMENTATION

It shall be the responsibility of the Contractor to coordinate with Division 17 regarding the requirements of control valves.

3.4 COORDINATION WITH OTHER MECHANICAL SUPPLIERS

The installation and operation of the valve and motorized actuators shall be the unit responsibility of the valve supplier.

3.5 CLEANING

All valves and appurtenances shall be flushed clean of all foreign matter together with the piping as specified in other sections.

+++ END OF SECTION ++

TABLE 40 05 86-A VALVE SCHEDULE

Qty	Valve Type	Service	Location	Inlet Dia. (inch)	Inlet Connect'n Type	Orifice (inch)	Working Pressure Range (psi)	Valve Design Pressure (psi)	Isolating Valve Type
5	AR	WW	5	2	NPT	2	110	200	BA
3	CV	WW	5	10	FLG	N/A	110	200	N/A
2	CV	WW	5	14	FLG	N/A	110	200	N/A
3	PV	WW	5	10	FLG	N/A	110	200	N/A
2	PV	WW	5	14	FLG	N/A	110	200	N/A
1	SR	WW	5	10	FLG	10	110	200	N/A
1	PV	WW	5	10	FLG	N/A	110	200	PV

Abbreviations that may be used in the Schedule:

Valve Type

Air Release Valve	AR
Air/Vacuum Valve	AV

Check Valve	CV
Combination Air Valve	CA
Eccentric Plug Valve	PV
Control Valve (Surge Relief Valve)	SR

Service

Waste Water	WW

Location Identification

Identification	Location
1	Influent Wet Well
2	Electrical Building
3	College Park Influent Flume
4	Screening Building
5	Effluent Wet Well

Inlet Connection

Flanged	F
Threaded	NPT

Isolating Valve Type

Ball Valve	BA
Butterfly Valve	BU
Plug Valve	PL
Gate Valve	GV

Accessories

Vacuum Check	VC
Throttling Device	TD
Anti-slam Device	SV
Outlet Cowl or Hood	OC
Inflow Prevention Device	IP

Required Features

Cast stainless steel body and cover	(1)
Fusion bonded exterior coating	(2)
Backflush attachments not required for Air Valve in wastewater service	(3)
Exterior surface to be painted with prime coat only	(4)

SECTION 15140

DUCTWORK SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete installation of all supports and anchors. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.
- C. Work Included:
 - 1. Duct, equipment hangers and supports.
 - 2. Equipment bases and supports.
 - 3. Sleeves and seals.
 - 4. Flashing and sealing equipment.
- D. Related Work Specified Elsewhere:
 - 1. Section 15050, BASIC MECHANICAL MATERIALS AND METHODS.
 - 2. Section 15891, DUCTWORK.
 - 3. Section 15910, DUCTWORK ACCESSORIES.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions. In addition, the following specific information shall be provided:

- A. Manufacturer's certification.
- B. Manufacturer's data.
- C. Shop drawings.
- D. Relevant Experience: Provide a list of such installations complete with installation description contact names, addresses, telephone numbers.
- E. Operation and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
1. NEC, National Electric Code.
 2. NEMA, Standards of National Electrical Manufacturers Association.
 3. OSHA, Occupational Safety and Health Act.
 4. ANSI, American National Standards Institute.
 5. ASTM, American Society for Testing Materials.
 6. AISI, American Iron and Steel Institute.
 7. NFPA, National Fire Protection Association.
- B. Experience: Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have furnished equipment for a minimum of five similar applications.

1.4 QUALITY STANDARDS

- A. The supports and anchors shall be furnished by a single manufacturer who shall assume sole responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings.
- B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.

1.5 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 HANGER RODS

Steel Hanger Rods: Threaded both ends, threaded one end or continuous threaded.

2.2 INSERTS

Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger.

2.3 SLEEVES

- A. Sleeves for round ductwork: Form with galvanized steel.
- B. Sleeves for rectangular ductwork: Form with galvanized steel or wood.
- C. Fire Stopping Insulation: Glass fiber type, noncombustible.
- D. Caulk: Sealant of type and quality specified in Section 07900, CAULKING AND SEALANTS.

2.4 FABRICATION

Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

2.5 FINISH

Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 INSERTS

- A. Provide inserts for suspended hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- B. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- C. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut flush with top of slab.

3.2 EQUIPMENT BASES AND SUPPORTS

- A. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- B. Construct support of steel members. Brace and fasten with flanges bolted to structure.

3.3 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. Where ductwork penetrates floor, ceiling, or wall, close off space between duct and adjacent work with stuffing fire stopping insulation and caulk seal. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Install chrome plated steel escutcheons at finished surfaces.

+++ END OF SECTION +++

SECTION 15250

MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of mechanical insulation. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the Contractor's recommendations and as shown on the drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any specific material. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the material being furnished. All costs associated with such changes and adjustments shall be included in the price bid for the Work shown and specified.
- C. The types of mechanical insulation specified in this Section include the following:
 - 1. Piping System Insulation - Flexible Unicellular.
 - 2. Ductwork System Insulation - Fiberglass.
- D. Related Work Specified Elsewhere:
 - 1. Section 15050, Basic Mechanical Materials and Methods.
 - 2. Section 15060, Piping and Appurtenances.
 - 3. Section 15891, Ductwork.
 - 4. Section 15910, Ductwork Accessories.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Manufacturer's technical product data and installation instructions for each type of mechanical insulation:
 - a) Manufacturer's product number.
 - b) k-Value and thickness.
 - c) Accessories included for each mechanical system requiring insulation.
 - 2. Maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required and whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84, NFPA 255 method. Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150. Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.
- C. Reference Standards: Comply with all Federal and State laws or ordinances, as well as the latest edition of all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. ASTM, American Society for Testing Materials.
 - 2. ASME, American Society of Mechanical Engineers.
 - 3. OSHA, Occupational Safety and Health Act.
 - 4. ANSI, American National Standards Institute.
 - 5. AWWA, American Water Works Association.
 - 6. NFPA, National Fire Protection Association.
 - 7. FM, Factory Mutual Engineering Corporation.
 - 8. UL, Underwriters Laboratories, Inc.

1.4 STORAGE AND PROTECTION

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

A.1 GENERAL

- A. Flexible unicellular piping insulation: ASTM C1 534, Type I.
- B. Board Type Insulation: Board type insulation material shall be fiberglass, minimum density of 3lbs/cu.ft., with factory applied foil-skrim-kraft 0.02 perm (maximum) vapor barrier. Thermal conductivity shall not exceed 0.23 BTUin/hr/Ft²/°F at 75 degrees F. Board type insulation shall be provided on exposed rectangular ductwork.
- C. Blanket Type Insulation: Blanket type insulation material shall be fiberglass,

minimum density 1 lb/cu.ft., and thermal conductivity of 0.27 BTUin/hr/ft2/°F at 75 degrees F mean temperature. Facing shall be factory applied 0.02 perm (maximum) vapor barrier, consisting of glass fiber scrim reinforced laminated facing of aluminum foil and Kraft paper. Blanket type insulation shall be provided on round ductwork and concealed rectangular ductwork.

- D. Provide staple, bands, wires, tape, anchors, corner angles, and similar accessories as recommended by insulation manufacturer for applications indicated.
- E. Provide cements, adhesives, coatings, sealers, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which mechanical insulation is to be installed. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 HVAC PIPING SYSTEM INSULATION

- A. Insulate sub-freezing HVAC piping systems with flexible unicellular, 1" thick for pipe sizes up to 1-1/2" above ground.
- B. Insulate sub-freezing HVAC piping systems with cellular glass, 1-1/2" thick for pipes underground.
- C. Insulate the following sub-freezing HVAC piping systems:
 - 1. Refrigerant suction lines between evaporators and compressors.
 - 2. Condensate drain piping

3.3 DUCTWORK SYSTEM INSULATION

- A. Insulate the following ductwork:
 - 1. Electrical Building: All ACU-1 supply ductwork.
- B. All exposed rectangular ductwork carrying conditioned air (heated or cooled) or return air located in conditioned space shall be insulated with 1-inch thick board type insulation.
- C. All ductwork carrying conditioned air (heated or cooled) or return air located in ceiling space, attic, mezzanine, concealed, or other non-conditioned areas shall be insulated with 2-inch thick blanket type insulation.

3.5 INSTALLATION OF PIPING INSULATION

Install insulation products in accordance with manufacturer's written instructions, these specifications and in accordance with recognized industry practices to ensure insulation serves its intended purpose.

- A. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- B. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- C. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing and acceptance of tests.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- F. Maintain integrity of vapor-barrier jackets on pipe insulation and protect to prevent puncture or other damage.
- G. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

3.6 INSTALLATION OF DUCTWORK INSULATION

- A. Install insulation products in accordance with manufacturer's written instructions, these specifications and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
 - 1. Install insulation materials with smooth and even surfaces.
 - 2. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
 - 3. Maintain integrity of vapor-barrier jackets on ductwork insulation and protect to prevent puncture and other damage.
 - 4. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
 - 5. Omit insulation on lined ductwork where internal insulation or sound absorbing linings have been installed, except as otherwise indicated.

- B. Protect outdoor insulation exposed to weather by installing outdoor protective finish or jacketing as recommended by manufacturer.
- C. Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

+++ END OF SECTION +++

SECTION 15262

SLIDE GATES

PART 1 - General

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install slide gates and appurtenances complete and operational.
2. Included are all labor, materials, tools and equipment necessary to install and test all slide gates, consisting of, but not limited to frames, discs, seals, stems, operators, floor stands, stem guides, anchorage, and all other appurtenances, in place and complete.
3. Extent of the equipment is shown on the Slide Gate Schedule located at the end of this Section.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the slide gates Work.

C. Related Sections:

1. Section 03055, Concrete.
2. Section 05051, Anchor Systems.
3. Section 09900, Painting. (Specifications for Surface Preparation and Shop Painting required under Section 15262, Slide gates, are under Section 09900, Painting.)

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS. D635-81 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position D648-82 Test Method for Deflection Temperature of Plastics Under Flexural Load NASA CR-1457, "Manual for Structural Stability Analysis of Sandwiched Plates and Shells" et al.
2. AMERICAN WATER WORKS ASSOCIATION (AWWA) C563 Standard for Composite Slide Gates.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
 - 2. Slide gates shall be the product of one manufacturer.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single slide gate manufacturer.
 - 2. The slide gate equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically designed for the specified service and shall be integrated into the overall assembly by the slide gate equipment manufacturer.
- C. Warranty and Guarantee:
 - 1. The Manufacturer shall guarantee the slide gates, when installed and operated as recommended by the Manufacturer, trouble-free operation for a period of ten (10) years. If the Owner or Engineer is not completely satisfied with the performance of the product, the Manufacturer shall remedy the problem at no cost or refund the materials and installation cost upon the return of the equipment. The Manufacturer shall guarantee the following:
 - a. Leakage shall be no more than that allowed by the AWWA C563 Standard during the guarantee period.
 - b. Door (disc) shall be free of sticking or binding as judged by the Engineer (move freely via operator provided) with no exercising required. Gate operators are to be warranted by the operator manufacturer per their standard warranty.
 - c. No exception or revision shall be taken to the warranty.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication, assembly, and installation diagrams.
 - b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - c. Wiring diagrams for electric motor operators.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, and engineering data.
 - b. Deviations from the Contract Documents.

- c. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.
- B. Informational Submittals: Submit the following:
 - 1. Support Design Information:
 - a. Submit for record purposes only the weight of each slide gate and expected opening and closing thrust loads on the supporting structure.
 - 2. Shop Test Results:
 - a. Submit results of required shop tests.
 - 3. Field Test Results:
 - a. Submit a written report giving the results of the field tests required.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Manuals:
 - a. Submit complete Installation, Operation and Maintenance Manuals including, test reports, maintenance data and schedules, description of operation and spare parts information.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Each package shall have an identifying mark and a complete list showing contents.
 - 2. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
 - 3. Handle all slide gates and appurtenances properly, in accordance with manufacturer's recommendations. Slide gates, which are distorted or otherwise damaged, will not be acceptable. Protect all bolt threads and ends from damage.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
 - 2. Store all mechanical equipment in covered storage off the ground and prevent condensation.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall

notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. General:

1. Design slide gates to safely withstand conditions listed in Slide gate Schedule, located at the end of the Section.
2. Slide gates shall be designed for the seating and unseating heads as listed in the gate schedule. Slide gates shall exceed the standard of AWWA C563. Exceeding the conformance to AWWA C563 applies to discs and frames with a safety factor of five (5) with regard to tensile, compressive and shear strength and with the requirement that all gates will yield no more leakage than shown in Section 6.8 (AWWA) Field Leakage Test. Materials of construction shall be suitable for the environment in which the slide gates shall be installed and operated.
3. Manual operators shall turn right to close, unless otherwise specified. Operators shall indicate the direction of operation.
4. Bolts, studs, cap screws, and adjusting screws shall be of ample section to withstand the force created by operation of the gate under a full head of water.
5. Downward opening slide gates shall be capable of being lowered to an elevation below the invert of the channel or opening.
6. Slide gates shall open to not less than 6-inches above the maximum water level in the channel in which they are installed.

2.2 MANUFACTURERS

A. Manufacturers: Provide equipment of one of the following:

1. Waterman Industries
2. Alfa Laval.
3. Hydro-gate.
4. Rodney Hunt-Fontaine Industries, Ltd.
5. Or Equal

2.3 FABRICATION

A. Materials of Construction:

1. Stainless Steel: For slide, rail and yoke, ASTM A 276, Type 316 stainless steel. All metal for slide gate parts shall have a minimum thickness of 1/4-inch.
2. Bronze Casting: For operating nut, thrust nut and lift nut, ASTM B 584 Alloy 865.

3. All bolts, studs, cap screws and adjusting screws shall be of Type 316 stainless steel.
4. Bolts and nuts shall have hexagon heads.
5. Gasket material and installation shall conform to manufacturer's recommendations.

B. Frame:

1. Shall be 316LSS with a 5/16" minimum metal thickness for all items. Frames are wall mounted against a 1" nominal grout base; no thimbles or flanges are needed or included.

C. Disc:

1. Shall be constructed with a reinforced rigid composite skin, having a minimum thickness of 1/8-inch on the outside. Slide (disc) shall have an internal matrix of carbon steel of suitable strength for the specified service. The total minimum slide thickness should not be less than 2". The slide (disc) outer surface skins shall be a homogeneous plastic material having extremely high tensile and impact strength, be nontoxic and shall be stabilized against ultraviolet light. The plastic material shall be an Aramid fiber from the KEVLAR family of fibers, and shall have the following minimum properties and shall be designed to limit the deflection to a maximum of 1/1000 of the span under design head conditions based upon horizontal support members only. Manufacturer shall submit drawings and comprehensive design criteria to substantiate that the required deflection figure for each door has been achieved. Safety factors shall be calculated for the disc under maximum head, and shear at the disc/seal interface. No substitute of fiber type will be acceptable.

FRP, GRP, plastic coated steel or externally reinforced slide (disc) shall not be acceptable. All welds on the slide shall be continuously welded and no stitch welding to be allowed.

2. PROPERTIES TABLE

Tensile Strength	15,400
Young's Modulus	1,756,000 psi
Flexural Strength	28,000 psi
Flexural Modulus	1,497,000 psi
Compressive Strength	30,200 psi
Impact Strength	9.65 ft-lb/in

Water Absorption	0.09 %
Specific Gravity	1.72
Coefficient of Thermal Expansion	1.6×10^{-5} per C
Heat Distortion Point	80 degrees C ASTM D648
Low Temperature Impact Strength	93% @ -20 C
Notch Sensitivity	Not notch sensitive
Weathering Properties	Excellent
Fire Resistance	Class 1 Spread of Flame, Rating BS476: Part 1: 1953 self-extinguishing, ASTM D635 - 56R
Chemical Resistance	Organics, Alkaline, Ozone (2 to 3 PPM)
Rigid Polyurethane foam shall be used as filler between the steel grid reinforcing system and shall be a min. of 7 LB density/cu.ft.	

D. Disc Guides:

1. Guides shall be of Type 316 stainless steel incorporating a sandwich type construction using plates and structural angles.
2. Guides shall be designed for maximum rigidity as columns to take the thrust developed during the slide gate operation under maximum head.
3. Guides shall extend beneath the opening a sufficient amount to support the disc in the fully open or closed position.

E. Stem:

1. All stems shall be the rising types. The entire stem, including extension stem, shall be Type 316 Stainless Steel solid bar. The sections of extension stems shall be joined together by solid couplings, threaded and keyed to the stems. All couplings of the same size shall be interchangeable.
Stems shall be furnished with adjustable, stem guides, spaced as necessary to maintain a slenderness ratio L/R of less than 200. Stems shall be of ample cross section to prevent distortion and shall have stub acme threads. Stems shall be designed to withstand tensile and compressive loads that occur under maximum operating conditions. Design for compressive loading shall meet AISC code where $K=1$ with a minimum safety Factor of 2 to 1. These requirements exceed AWWA standards. Stems shall be cold rolled

or cut with a double start stub acme thread and a finish of 32 microns or less.

Stems shall be fixed to the disc by a threaded and keyed assembly into a lifting nut attached to the disc in a lifting bracket, which is bolted to the disc. The bolts securing the bracket shall be in tension and not shear. Bolts in shear will not be acceptable as they will bind against the outer material causing stress.

- F. Yoke (For Self Contained Type Gates):
 - 1. Furnish tops of the extended guides with a yoke for mounting of the lifting device.
 - 2. Construct the yoke of structural shapes of sufficient strength to take the full thrust created by operating the gate under the maximum specified head.
 - 3. Attach the yoke to the framework by bolting or welding to permit removal of the gate slide and stem.
- G. Seals:
 - 1. The sealing arrangement for the reinforced plastic slide gates shall comprise of sealing faces and side guides constructed of ultra high molecular weight polyolefin having an extremely low coefficient of friction and a backing constructed of highly resilient expanded neoprene. Guides and seating of the gate shall be easily adjustable (min. 5/8-inch). All moving contact surfaces shall be compatible to each other there by minimizing sticking / jamming and making the operation easy. Leakage rates shall be one-half (½) that allowed by AWWA C563.

2.4 APPURTENANCES

- A. Stem Guides:
 - 1. Stem guides shall be fabricated from Type 316 stainless steel and shall be equipped with UHMW polyethylene or UHMW polymer.
 - 2. Guides shall be adjustable in two directions and shall be spaced so that stems have a maximum unsupported length of 84-inches.
 - 3. Anchor bolts for stem guides shall be Type 316 stainless steel.
- B. Anchor Bolts:
 - 1. Provide Type 316 stainless steel anchor bolts as required for stem guides, floorstands, and all equipment or appurtenances, which must be secured to concrete walls or floors. Anchor bolts shall be of ample size and strength for the purpose intended, and shall be furnished by the manufacturer. Anchor bolts shall be hooked, and provided for direct embedment during placement of concrete.
- C. Stem Cover:

1. Furnish all stems with a clear polycarbonate or butyrate plastic pipe stem cover. Covers shall be furnished with a cast aluminum adaptor for mounting covers to floor stands. Stem covers shall be designed and furnished with gasketing and breathers to eliminate water intrusion into operators and condensation within the covers.
2. The stem cover shall be equipped with a clear mylar position indicating tape. The tape shall be field applied on the stem cover after the gate has been installed and positioned. As a minimum, the tape shall indicate the gate position at 1/4 open, 1/2 open, 3/4 open and fully open.

D. Manual Operators:

1. Manual operation shall be by handwheel or crank operated floorstand or benchstand as shown and specified.
2. Handwheel-operated type shall be without gear reduction and crank-operated type will have either a single or double gear reduction, as required. Each type shall be provided with a threaded cast manganese bronze lift nut to engage the operating stem.
3. Provide anti-friction bearings to properly support both opening and closing thrusts.
4. Stands shall operate the gates under the specified operating head with not greater than a 40-pound pull on the crank or handwheel.
5. All components shall be totally enclosed in a cast-iron weather-proof housing. Provide positive mechanical seals to exclude moisture and dirt and prevent leakage of lubricant out of the unit.
6. Provide lubricating fittings for all gears and bearings.
7. Stands shall include a cast-iron pedestal designed to position the input shaft approximately 36-inches above the operating floor. An arrow with the word "OPEN" shall be permanently attached or cast on the floorstand indicating the direction of rotation to open the slide gate.
8. Removable cranks shall be cast-iron with a revolving brass grip. Removable handwheel shall be fabricated steel designed for rough treatment and minimum weight.
9. For self-contained type slide gates, the distance between handwheel or crank operator and the operating floor shall be 36-inches minimum and 48-inches maximum.
10. Crank-operated gates shall be provided with nut-operator drives as noted on Slide gate Schedule.
11. Operators shall be furnished with a limit switch to indicate fully closed position, where shown.
12. Provide mechanical stops adjustable $\pm$ five degrees at each end of travel.

E. Electric Operators:

1. Electric motor operators shall be furnished for continuous duty, open close operation.
2. Electric motor operator shall be capable of providing not less than 1-1/2 times the required operator torque for opening and closing of the slide gate.
3. Operator shall be required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.
4. Operator gear reducer shall be provided with a pair of limit switches and torque switches and a reversing contactor. The torque switches shall be adjustable.
5. Limit switches furnished for all slide gates shall be equipped with 16 contacts (four rotors with four contacts each). Contacts shall open and close as shown.
6. Reversing starter, limit switches, and torque switches shall be supplied and mounted on the operators.
7. Where shown, furnish a resistance-to-current converter for remote position indication.
8. Electric motor shall be totally enclosed, sized to open or close the slide gate full cycle in approximately (--1--) seconds, and suitable for operation on 480 volt, 3 phase, 60 Hz power. All electrical equipment, which is mounted on the operator, shall be housed enclosures required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.
9. Starter shall include an adequately sized, fused, control power transformer, 480 volt primary and 120 volt secondary.
10. Manufacturer shall comply with all requirements of the electrical control schematic diagrams as shown.
11. The slide gates shall be controlled as shown.
12. Where shown or specified, provide electric operator for modulating continuous duty service.
13. Provide mechanical stops adjustable $\pm$ five degrees at each end of travel.
14. Electric motor operator shall include a thermostatically controlled space heater.
15. A handwheel shall be provided for manual operation. It shall not rotate during motor operation. The change from motor operation to handwheel operation shall be accomplished by a positive declutching device, which shall disengage the motor and motor gearing mechanically, but not electrically. Hand operation shall not require more than 80 pounds of rim effort at maximum required torque.
16. Each slide gate actuator shall be provided with an integral dial-type disc position indicator.

17. Each actuator shall be furnished with a Local-Off-Remote Selector Switch, a Raise-Stop-Lower switch for local mode.
18. In Remote mode, actuator shall be able to accept a remote open and remote closed (120 of 24) comment from Owner's SCADA.
19. Actuator shall include a set of auxiliary contacts (120V / 5A) for fault indication, Remote Selector Position, 100% Open, and 100% Closed position.
20. Manufacturers: Provide equipment of one of the following:
 - a. ROTORK
 - b. EIM.
 - c. Or equal.

F. Identification: Identify each slide gate with a stainless steel nameplate stamped with the approved designation as shown in the Slide gate Schedule, located at the end of this Section. Nameplate shall be permanently fastened to the gate at the factory.

2.5 SURFACE PREPARATION AND PAINTING

- A. Clean, prime coat, and finish coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900, Painting.
- B. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound, which shall be maintained during storage, and until equipment begins operation.
- C. CONTRACTOR shall certify, in writing, that the shop primer and coating system conforms to the requirements of Section 09900, Painting.

2.6 SOURCE QUALITY CONTROL

- A. Shop Tests:
 1. Test each slide gate fully assembled in the vertical position for proper seating.
 2. Fully open and close gate disc in its guide system to ensure that it operates freely.
 3. Operate and test floor stands, bench stands and motor operators to ensure proper assembly and operation.

2.7 SLIDE GATE SCHEDULE

- A. The Slide Gate Schedule is located at the end of this Section. Conform to type, size, operation and other data specified, unless otherwise approved by ENGINEER.
- B. Provide all slide gates as shown and listed in the schedule.
- C. Schedule Abbreviation:

1. Type:
 - a. EF - Embedded Frame.
 - b. SM - Surface Mounted Frame.
 - c. WG - Downward Opening Weir Gate.
2. Frame:
 - a. SC – Self-Contained.
 - b. NSC – Non-self-Contained.
3. Operator Type:
 - a. CO - Crank Operated.
 - b. HW - Handwheel.
 - c. MO - Motor Operated.

- D. The seating and unseating design head as stated in the Slide gate Schedule is based on the head measured to the centerline of the gate in its closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install slide gate equipment in accordance with manufacturer's instructions and recommendations.
- B. Brace guides and frames during placement of concrete.
- C. Set anchor bolts in accordance with approved Shop Drawings and manufacturer's recommendations.
- D. Provide minimum of 1-inch of non-shrink grout below all floorstands.
- E. Adjust all parts and components as required to provide correct operation.

3.2 START-UP AND FIELD TESTS

- A. After CONTRACTOR and ENGINEER have mutually agreed that the equipment installation is complete and ready for continuous operation, CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a functional field test and a leakage test of each slide gate in the presence of ENGINEER to demonstrate that each slide gate furnished will function correctly and that maximum permissible leakage is not exceeded.
 1. Functional Tests:
 - a. Each slide gate with appurtenances shall be field-tested. Tests shall demonstrate to ENGINEER that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by CONTRACTOR at their expense. OWNER

will furnish all power, and incidental material and labor required for the tests.

2. Leakage Tests:
 - a. Maximum permissible leakage shall be in accordance with the requirements of Paragraph 2.1, above. Excess leakage shall be reduced to meet specified requirements by adjusting the gate, or replacement will be required.
3. In the event that the manufacturer is unable to demonstrate to ENGINEER that their equipment meets the requirements of the tests, the deficient equipment will be rejected and CONTRACTOR shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements. No separate payments shall be made for adjustments and/or modifications.

3.3 MANUFACTURER'S SERVICES

- A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of one (2) visits, minimum eight (4) hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

Gate ID	Location	Type	Quantity	Opening Size (W x H)	Frame	Gate Invert Elevation	Floor Mounting Elevation	Design Head (Seating/ Unseating) (ft.)	Operator
SG-4.1 SG-4.2 SG-4.3	Screening Building	EF	3	36x36	SC	953.84	960.00	5	HW/MO

Note 1: Design head measured from invert of gate.

END OF SECTION

SECTION 15530

REFRIGERATION PIPING

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of refrigeration piping system. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the Contractor's recommendations and as shown on the drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any specific material. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the material being furnished. All costs associated with such changes and adjustments shall be included in the price bid for the Work shown and specified.
- C. The refrigerant piping is used for air conditioning applications and includes the following:
 - 1. Pipes, tubing, fittings and specialties.
 - 2. Special duty valves.
 - 3. Refrigerants.
- D. Related Work Specified Elsewhere:
 - 1. Section 02000, Site Work.
 - 2. Section 15050, Basic Mechanical Materials and Methods.
 - 3. Section 15735, Split System Air Conditioning Units.
 - 4. Section 15250, Mechanical Insulation
- E. Products installed but not furnished under this Section include pre-charged tubing, refrigerant specialties, and refrigerant accessories furnished as an integral part of or separately with packaged air conditioning equipment.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Product data for the following products:

- a. Each type valve specified.
 - b. Each type refrigerant piping specialty specified.
2. Maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.
3. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment
4. Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under paragraph 1.03 below.

1.03 QUALITY ASSURANCE

- A. Qualify brazing processes and brazing operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- B. Reference Standards: Comply with all Federal and State laws or ordinances, as well as the latest edition of all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 1. ASTM, American Society for Testing Materials.
 2. ASME, American Society of Mechanical Engineers.
 3. OSHA, Occupational Safety and Health Act.
 4. ANSI, American National Standards Institute.
 5. ASHRAE, American Society of Heating and Refrigeration Architectural Engineers.
 6. NFPA, National Fire Protection Association.
 7. FM, Factory Mutual Engineering Corporation.
 8. UL, Underwriters Laboratories, Inc.
 9. ARI, Air Conditioning and Refrigeration Institute.

PART 2 - PRODUCTS

2.01 PIPING AND TUBING MATERIALS

- A. Refer to Part 3 for identification of systems where the below specified pipe and fitting materials are used. Refrigerant piping shall be in accordance with ANSI B31.5 and ANSI/ASHRAE Standard 15 Safety Code for Refrigeration.
 1. Copper Tubing: ASTM B 280, Type ACR, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.
 2. Copper Tubing: ASTM B 88, Type L, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing.

- B. Fittings shall be wrought-copper in accordance with ANSI B16.22, streamlined pattern. Brazing filler materials shall be in accordance with AWS A5.8, Classification BAg-1, Silver.
- C. Complete valve assembly shall be UL-listed and designed to conform to ARI 760.
 - 1. Globe: 450 psig maximum operating pressure, 275° F maximum operating temperature; cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through pattern, with solder-end connections.
 - 2. Check Valves smaller than 7/8 inch: 500 psig maximum operating pressure, 300° F maximum operating temperature; cast brass body, with removable piston, Teflon seat and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.
 - 3. Check Valves 7/8 inch and larger: 450 psig maximum operating pressure, 300° F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.
 - 4. Solenoid Valves: 250° F temperature rating, 400 psig working pressure; forged brass with Teflon valve seat, two-way straight through pattern, and solder-end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz normally closed holding coil.
 - 5. Evaporator Pressure Regulating Valves: Pilot-operated, forged brass or case bronze; complete with pilot operator, stainless steel bottom spring, pressure gage tappings, 24 volts DC, 50/60 Hz, standard coil; and wrought-copper fittings for solder-end connections.
 - 6. Thermal Expansion Valves: Thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

2.02 REFRIGERANT PIPING SPECIALTIES

- A. Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.
 - 1. Strainers: 500 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder-end connections.
 - 2. Moisture/liquid Indicators: 500 psig maximum working pressure, 200° F maximum operating temperature; forged brass body with replaceable

- polished optical viewing window and solder-end connections.
3. Filter-driers: 500 psig maximum working pressure; steel shell, flange ring and spring, ductile iron cover plate with steel cap screws, and wrought copper fittings for solder-end connections. Furnish complete with replaceable filter-drier core kit, including gaskets as follows:
 - a. Standard capacity desiccant sieves to provide micron filtration.
 - b. High capacity desiccant sieves to provide micron filtration and extra drying capacity.
 4. Suction Line Filter-Drier: 350 psig maximum working pressure, 225° F maximum operating temperature; steel shell and wrought copper fittings for solder-end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.
 5. Suction Line Filters: 500 psig maximum working pressure; steel shell, flange ring and spring, ductile iron cover plate with steel cap screws, and wrought copper fittings for solder-end connections. Furnish complete with replaceable filter core kit, including gaskets as follows:
 - a. Flanged unions shall be rated for 400 psig maximum working pressure, 330° F maximum operating temperature; two brass tailpiece adapters for solder-end connections to copper tubing; flanges for 7/8 inch through 1-5/8 inch unions shall be forged steel, and for 2-1/8 inch through 3-1/8 inch shall be ductile iron; four plated steel bolts, with silicon bronze nuts and fiber gasket. Flanges and bolts shall have factory-applied rust-resistant coating.
 - b. Flexible connectors shall be rated for 500 psig maximum working pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder-end connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.
 6. Refrigerant R-410A.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.

3.02 PIPE APPLICATIONS

- A. Use Type L or Type ACR drawn copper tubing with wrought copper fittings and brazed joints above ground, within building. Use Type K, annealed temper copper tubing for 2 inch and smaller without joints, below ground and within slabs. Mechanical fittings of the crimp or flair type are not permitted.
- B. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Cleaning article below.

3.03 PIPING INSTALLATIONS

- A. Install refrigerant piping in accordance with ASHRAE Standard 15- The Safety Code for Mechanical Refrigeration.
- B. Install piping in as short and direct arrangement as possible to minimize pressure drop.
 - 1. Exposed piping shall be installed at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
 - 2. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- C. Install piping for minimum number of joints using as few elbows and other fittings as possible.
 - 1. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- D. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
 - 1. Unions shall be provided to allow removal of solenoid valves, pressure regulating valves, expansion valves and at connections to compressors and evaporators.
 - 2. Flexible connectors shall be provided at the inlet and discharge connection of compressors.
- E. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls or ceilings, sized to permit installation of full thickness insulation.
 - 1. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
 - 2. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
 - 3. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing of valves.
- F. Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
 - 1. Do not install insulation until system testing has been completed and all leaks

have been eliminated.

- G. Install branch tie-in lines to parallel compressor equal length, and pipe identically and symmetrically.
- H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- I. Slope refrigerant piping as follows:
 - 1. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.
 - 2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - 3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- J. Penetrations shall be as follows:
 - 1. Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.
 - 2. Where pipes pass through fire rated wall, partitions, ceilings and floors, maintain the fire rated integrity.
- K. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.
- L. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver.
 - 1. Install moisture/liquid indicators in lines larger than 2-1/8-inch OD, using a bypass line.

3.04 HANGERS AND SUPPORTS

- A. Hanger, supports, and anchors are specified in Section 15060, Piping and Appurtenances. Conform to the table below for pipe attachments and maximum spacing of supports:
 - 1. Adjustable steel clevis hanger for individual horizontal runs less than 20 feet in length.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

3. Pipe rollers compete supports for multiple horizontal runs, 20 feet or longer supported by a trapeze.
4. Spring hangers to support vertical runs. Support vertical runs at each floor.
5. Hangers shall be provided with the following minimum rod sized and maximum spacing:

Nom. Pipe Size	Max. Span - Ft.	Min.Rod Size - Inches
Up to 1"	7	1/2
1-1/2"	9	1/2
2"	10	1/2

3.05 PIPE JOINT CONSTRUCTION

- A. Brazed joints shall comply with the procedures contained in the AWS Brazing Manual.
 1. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.
 2. Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.

3.06 VALVE INSTALLATIONS

- A. Install refrigerant valves where indicated and in accordance with manufacturer's instructions.
 1. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators and elsewhere as indicated.
 2. Install a full sized, 3-valve bypass around each drier.
 3. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.
 - a. Electrical wiring for solenoid valves is specified in Division 16, Electrical.
 4. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
 - a. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
 - b. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
 - c. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.
 - d. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at

- the bulb location.
5. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

3.07 FIELD QUALITY CONTROL

- A. Inspect, test and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.
 1. Repair leaking joints using new materials and retest for leaks.

3.08 CLEANING

- A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fittings using the following cleaning procedure:
 1. Remove coarse particles of dirt and dust by drawing a clean, lint-less cloth through the tubing by means of a wire or an electrician's tape.
 2. Draw a clean, lint-less cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 3. Draw a clean, lint-less cloth saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 4. Finally, draw a clean, dry, lint-less cloth thorough the tube or pipe.

3.09 ADJUSTING AND CLEANING

- A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Clean and inspect refrigerant piping system in accordance with the requirements of Section 15050.
- C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.10 CHARGING

- A. Charge system using the following procedure
 1. Install core in filter dryer after leak test but before evacuation.
 2. Evacuate refrigerant system with vacuum pump; until temperature of 35°F is indicated on vacuum dehydration indicator.
 3. During excavation, apply heat to pocket, elbows and low spots piping.
 4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.
6. Complete charging of system, using new filter dryer core in charging line.
Provide full operating charge.

+++ END OF SECTION 15530 +++

SECTION 15700

ELECTRICAL UNIT HEATERS

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of all electrical unit heaters and controls. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be included in the price bid for the Work shown and specified.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Manufacturer's Certification.
- B. Manufacturer's data.
- C. Operation and maintenance manuals.
- D. Complete wiring and control diagrams.

1.3 QUALITY ASSURANCE

- A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as the latest edition of all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. NEC, National Electric Code.
 - 2. NEMA, Standards of National Electrical Manufacturers Association.
 - 3. OSHA, Occupational Safety and Health Act.
 - 4. ANSI, American National Standards Institute.
 - 5. ASTM, American Society for Testing Materials.

6. AISI, American Iron and Steel Institute.
7. AGMA, American Gear Manufacturer's Association.
8. AFBMA, Anti-Friction Bearing Manufacturer's Association.
9. NFPA, National Fire Protection Association.

B. Experience. Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have furnished equipment for a minimum of five similar applications that have a demonstrated record of successful operation. Provide a list of such installations complete with installation description contact names, addresses, telephone numbers. This reference list shall be submitted with the shop drawings.

1.4 QUALITY STANDARDS

- A. The electrical unit heaters shall be furnished by a single manufacturer who shall assume sole responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings.
- B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions. A certificate of unit responsibility shall be provided. Nothing in this provision, however, shall be construed as relieving the Contractor of his overall responsibility for this portion of the work.
- C. Unit responsibility certificates provided by suppliers, vendors, or other second party representatives of the electrical unit heater manufacturer shall not be accepted.
- D. Manufacturer's offering products that comply with these specifications include:
 1. Electric Unit Heaters-Chromalox, Model HD3D
 2. Or equal.

1.5 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 ELECTRICAL UNIT HEATER

Provide and install electrical unit heater as described herein and as indicated on the Drawings.

1. Unit heater shall be horizontal, and wall mounted.
2. Furnish electrical heater with mounting brackets.

3. Unit heater heat bank shall consist of patented Chromalox spiral metal sheath fintube electric heating elements with built-in overheat protection.
4. Furnish heavy duty magnetic control contactor.
5. Unit heater shall be hose-down corrosion resistant blower type.

2.2 CONTROLS

Unit heaters shall be energized by their respective factory furnished thermostats, set at 55°F (adjustable).

PART 3 - EXECUTION:

3.1 INSTALLATION

The equipment shall be installed in strict conformance with the approved shop drawings and manufacturer's installation instructions.

3.2 EQUIPMENT TESTING

After completion of the work, test and regulate heating coils, and unit heaters, to conform to conditions indicated on the Drawings. Contractor shall adjust apparatus for securing proper volumes and conditions.

+++ END OF SECTION 15700 +++

SECTION 15735

SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 - GENERAL

1.01 SCOPE

- A. Furnish and install air conditioning units suitable for computer and electrical room type applications with very high sensible heat ratios. The units shall be of the size, type, capacity, and characteristics described within the Contract Documents.

1.02 REFERENCES

- A. This Specification references the latest edition of the publications listed below. Work shall be performed, and materials shall be furnished in accordance with these publications as referenced herein:
 - 1. International Mechanical Code
 - 2. Underwriter's Laboratory (UL) Standards
 - 3. American National Standards Institute (ANSI) Standards
ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration
 - 4. National Fire Protection Association (NFPA) Standards
NFPA 70 National Electrical Code
NFPA 90A Installation of Air conditioning and Ventilating Systems
 - 5. Air Moving and Control Association (AMCA)
AMCA 210 Laboratory Methods for Testing Fans for Rating
AMCA 301 Method of Publishing Sound Ratings for Air Moving Devices

1.03 QUALITY ASSURANCE

- A. The equipment manufacturer shall furnish a factory-trained representative to oversee the Contractor's test and start-up of equipment. The manufacturer's representative shall verify that the installation is done in accordance with the manufacturer's published guidelines and shall validate the manufacturer's warranty.

1.04 WARRANTY

- A. The warranty shall prevail through the first 12 months following start-up. Compressors shall be guaranteed for a period of five years following start-up.
- B. Normal wearing items such as air filters, fan belts, etc. are excluded from this coverage.

1.05 SUBMITTALS

- A. Submit product data in accordance with the provisions of Division 1.
- B. Submittal data shall be complete with dimensional and performance data sufficient to verify conformance with all scheduled unit capacities.
- C. Submit installation and start-up instructions for units and all accessory items.
- D. Submit product data on the following at the minimum:
 - 1. Identification by equipment number.
 - 2. Performance Data: Including air quantity, KW input, brake horsepower, fan rpm, velocities, and pressure drops across various sections of the unit.
 - 3. Equipment operating weight.
 - 4. Catalog data marked to indicate specified components used.
 - 5. Unit specifications and Drawings describing construction methods, including materials, metal gauges, and component spacing and thickness.
 - 6. Fan characteristic curve for each fan selection.
 - 7. Operating sound level data of fan.
 - 8. Arrangement of unit.
 - 9. Complete dimensional data of each respective unit.
 - 10. Arrangement, locations, and size of drains and electrical connections.
 - 11. Cooling performance of unit.
 - 12. Complete description of filter media including materials, thickness, efficiency, and pressure drop at design airflow rates.
 - 13. Quantities and connection sizes of refrigeration pipes.
 - 14. Installation notes and mounting details.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Both indoor units and outdoor condensers shall be shop fabricated, completely factory assembled, tested, piped, and wired. All operating and safety controls shall be furnished and factory installed.
- B. The air conditioning systems shall be designed to maintain proper temperature and humidity conditions in the rooms containing electrical and electronic equipment.
- C. The units shall be designed for high sensible heat ratio areas such as electrical, telecom, and computer rooms.
- D. The units shall meet or exceed the capacity and performance characteristics called for in the Equipment Schedules on the Plans.
- E. Acceptable Manufacturers: Liebert Corporation, Data Aire, and Stulz.

2.02 Cabinet and Frame

- A. The cabinet of the unit shall be built on a one-piece welded frame with removable panels on four sides of the unit for easy service access with ¼-turn zeus fasteners.
- B. The framework shall be fabricated using minimum 14 gauge MIG welded tubular steel, finished using a powder paint coating process for maximum corrosion protection. The color of the unit shall be as selected by the Owner.
- C. All cabinet panels including access door panels shall be formed and welded from 18 gauge steel, finished with a textured powder coat paint process and insulated with 1" thick, 1.5 lb/ft³ density fiberglass insulation. All insulation products shall comply with NFPA-90A requirements for flame spread and smoke generation. Insulation adhesive shall be UL listed.
- D. All panels shall be locked with ¼-turn captive fasteners to quickly and easily facilitate internal access.

2.03 Evaporator Fan .

- A. Fan shall be capable of delivering the air quantity at the external static pressure specified in the Equipment Schedules.
- B. Fan shall be centrifugal, forward curved, double width double inlet, and shall be statically and dynamically balanced as a complete assembly to a maximum vibration level of 2.6 mils in any plane.
- C. Fan shall be mounted in the unit in a draw through arrangement. The fan shall be mounted on a common shaft and shall be belt driven by one motor using a belt driven sheave. The fan shaft shall be heavy-duty steel and shall be supported using self-aligning pillow block ball bearings having a minimum life span of 100,000 hours. Fan bearings shall be supplied with grease zert fittings.
- D. Fan motors shall be standard efficiency open drip proof fan cooled design with a minimum efficiency rating of 92% using Class F insulation to prevent contamination of the air stream and tripping of the smoke detector in the event of a motor failure. Fan motor speed shall not exceed 1,750 rpm. Fan selection shall be made so that the fan motor does not operate within the service factor range of the motor. Fan motors shall meet or exceed standard IP54.
- E. All parts of the fan assembly shall be manufactured using heavy gauge steel. All parts of the fan assembly (fan wheels and scroll housing where applicable) shall be painted, galvanized or corrosion treated prior to unit assembly.

- F. The fan drive package shall be multi V-belt, variable pitch sized for 200% of the motor horsepower. All belts shall be matched sets.

2.04 Refrigeration Systems

- A. Each refrigeration circuit shall include hot gas mufflers, liquid line filter dryers, refrigerant sight glass with moisture indicator (adjustable), externally equalized expansion valves, and liquid line solenoid valves.
- B. The compressors shall be located in a separate compartment so they may be serviced during operation of the equipment. The compressor shall be scroll type with vibration isolators, thermal overloads, oil sight glass, manual reset high pressure switch, pump down low pressure switch, suction line strainer, reversible oil pumps for forced feed lubrication, a maximum operating speed of 1,750 RPM at 60 Hz, and a minimum EER of 11.1.
- C. The compressor control system shall have an automatic lead/lag sequencing feature that equalizes the run time of compressors in units with dual refrigeration circuits.
- D. Compressor shall be equipped with a positive start feature to avoid compressor short cycling and low-pressure lockout during winter start-up. The microprocessor control shall prevent compressor short cycling by delaying a compressor restart by 3 minutes from the last start.
- E. All refrigeration circuits shall be pre-piped and factory leak tested ready for field connection. All interconnecting refrigerant piping shall be of type L copper pipe. All units shall be factory run tested with refrigerant to verify operation prior to shipping.
- F. Evaporator coil shall be an A-frame design. Coil shall be manufactured using 3/8", 1/2", or 5/8" O.D. copper tubes mechanically bonded to aluminum fins. Fin density shall not exceed 14 FPI. Coil shall be a minimum of 3 rows. Coil(s) circuiting shall be inter-twined in a counter-flow configuration.
- G. The refrigeration circuit shall include the following refrigeration specialties: thermal expansion valve with external equalizer, refrigerant distributor, liquid line pumpdown solenoid valve, liquid line sight glass, liquid line filter-dryer, fully field adjustable high and low pressure cut-out switches, suction line strainer, suction, liquid, and hot gas line gauge ports, suction and liquid line service valves, and hot gas muffler.

2.05 Evaporator Drain Pan

- A. A stainless steel, corrosion free condensate drain pan shall be provided under the evaporator coil.

2.06 Condensate Pump

- A. The unit manufacturer shall provide a condensate pump (shipped loose for field installation) designed to remove condensate from evaporator (and humidifier when specified). Pump shall be capable of pumping at a rate of 25 GPH against 15' of head.
- B. Pump model supplied shall be readily available from any local refrigeration part supplier.
- C. Unit manufacturer shall provide factory wiring, relays, fuses, and/or contactors for fully automatic pump operation. The condensate pump shall be powered using a separate transformer (if transformer is required) from the transformer powering the unit microprocessor controls.

2.07 Air Filters

- A. The filter chamber shall be an integral part of the system, located at the entrance of return air path. The filter chamber shall have the provision to house 4" filters.
- B. The filters shall be minimum MERV 8 rating and shall be listed as UL Class 2.
- C. Furnish three sets of filters for each unit.

2.08 Unit Controls

- A. The unit manufacturer shall provide microprocessor-based control system with automatic control and monitoring, LCD backlit display panel, and control keys for user input.
- B. The controls shall be menu driven with on-screen prompts for easy user operation. The display shall include system information such as room conditions, operational status, alarms, control and alarm set points, and all user selections including alarm delays, sensor calibration, DIP switch selections, and diagnostics. All indicators shall be language form. No symbols or codes shall be acceptable.
- C. System configuration and setting shall be stored in nonvolatile memory and safeguarded in the event of power failure.
- D. The system shall have programmable password access to prevent unauthorized changes of the system configuration and settings.
- E. The control system shall have a built-in testing routine to simplify field testing and troubleshooting.

- F. The system shall have a manual disconnect switch of the non-locking type, which can be accessed outside of the unit while the door is closed. High voltage electrical components shall not be accessible unless the switch is off.

2.09 Microprocessor Controller Alarms

- A. The control system shall have the following alarms:
 - 1. High/Low temperature
 - 2. High/Low humidity
 - 3. Short cycle
 - 4. Compressor overload
 - 5. High/Low voltage
 - 6. Filter dirty
 - 7. Fan overload
 - 8. Loss of airflow
 - 9. High head pressure
 - 10. Low suction pressure
 - 11. Loss of power
 - 12. Smoke detected
 - 13. Water under floor
 - 14. Common fault alarm for remote reporting
- B. Alarm messages, when programmed, shall comprise text description and occurrence time. Messages shall be ranked in the sequence of occurrence for fault analysis.
- C. When a programmed alarm condition exists, the factory mounted audible alarm shall sound and the common alarm output shall close until acknowledged. Active alarm record shall remain until the alarm condition is cleared.
- D. A historical event log shall be provided.

2.10 Liquid Detection System

- A. Unit manufacturer shall provide pre-wired liquid detection single point sensors. Sensors shall be pre-wired at the factory to the unit microprocessor and ready for placement in the field by the installing contractor.
- B. 2 sensors shall be provided per unit.

2.11 Smoke Detector

- A. Where called out in the equipment schedules on the Drawings, provide a factory mounted and wired smoke detector to shut unit down in the event of the presence of smoke.

2.12 Air-Cooled Condenser

- A. Condenser shall be supplied by the manufacturer of air conditioner unit. The condenser shall be sized to reject the unit's total heat of rejection, plus 3.5% at the outdoor design conditions applicable to the Project location. Any reduction in the heat transfer performance due to corrosion resistant coating shall be accounted while sizing the condenser.
- B. The air-cooled condenser shall be low-profile, slow speed, multiple direct drive, propeller fan type. The condenser shall be constructed of heavy gauge aluminum.
- C. The condenser coil shall be constructed of aluminum fins and copper tubes staggered in direction of airflow and arranged for vertical air discharge. Condenser coil shall be factory leak tested to 300 psig.
- D. The low ambient control for condenser shall be with variable fan speed control. The fan speed control system shall provide positive start-up and operation in ambient temperatures as low as -20 deg F. The control system shall be complete with transducers, thermostats and electrical control circuit, factory pre-wired in the control panel. The transducer shall automatically sense the head pressure of the compressor and control the variable speed fan on the condenser to properly maintain the head pressure.
- E. Manufacturer shall provide a factory-mounted, non-fused, locking disconnect.

PART 3 EXECUTION

3.01 Installation

- A. Locate units to provide manufacturer's suggested clearances for service access to filters, motors, drives, and fan bearings. Sufficient clearance shall be allotted for removal of fan shaft and coil. Install equipment so that it is level and properly supported.
- B. Install and adjust each unit in accordance with the Drawings and the manufacturer's recommendations. Install all safety devices as recommended by manufacturer and/or required by local code.
- C. Isolate sheet metal duct connections from all portions of the unit using flex connections.

- D. The installing contractor is responsible for providing refrigerant and charging the unit.
- E. The installing contractor shall supply and install control wiring, line voltage wiring, and refrigerant piping between indoor and outdoor units.
- F. Demonstrate operation of unit complete with all control functions and safety devices. Provide written certification that such demonstration has been successfully completed to the Engineer.
- G. Anchor condensing units to service pads with full-size, type 316 stainless steel, ½” minimum diameter bolts, minimum 4-inches embedment. Minimum of one bolt per leg is required.
- H. Make certain that piping connections to equipment do not cause any strain on equipment. Route condensate piping to drain in accordance with applicable codes.
- I. Make certain that vibration isolation has been installed per manufacturer’s instructions and isolation devices are performing satisfactorily.
- J. Manufacturer’s representative shall verify that all shipping lugs and component tiedowns have been removed and/or placed in the operating position prior to equipment start-up.
- K. Install new air filters prior to final acceptance and occupancy by the owner. Do not operate the units at any time without proper air filters in place.
- L. Startup: Installing contractor’s technician shall be responsible for startup of the equipment under direct supervision of a factory-trained and qualified service technician.
- M. Checkout: Manufacturer shall provide a factory-trained service representative to verify the proper operation of the equipment. Prior to startup, the representative shall inspect the installation, including the external interlock and power connections. Once the prestart check is completed, he or she shall then supervise initial operation and the calibration of operating and safety controls.
- N. The factory trained service representative shall forward a startup report in three copies to the Engineer when the unit is operating properly. The report shall contain all pressure and control settings, alarm response settings, run condition voltage readings per phase, suction temperature and pressure at compressor, discharge temperature and pressure at compressor, liquid line temperature and pressure and shall list minor discrepancies to be corrected which do not affect safe and reliable operation.

- O. One additional copy of the startup report and one copy of installation, operation, and maintenance manual, including sources for repair parts, shall be left in the control panel of the unit.

3.02 Adjusting and Cleaning

- A. Air System Balance: As specified in Section 15990 - Testing, Adjusting, and Balancing of HVAC Systems.
- B. Lubricate unsealed bearings prior to startup.
- C. Do not operate units until filters are installed. If operated without filters, completely clean ductwork, coils, fans and fan scrolls, and the interior of the unit.

+++ END OF SECTION 15735 +++

SECTION 15865

CORROSION CONTROL UNIT

PART 1 - GENERAL

1.1 SCOPE

- A. Provide corrosion control unit to remove the corrosive gases from the space.
- B. The Contractor is advised that all drawings shall be for general reference.
- C. The Contractor shall provide all equipment and work indicated below unless otherwise noted and any additional work to produce a completely finished job.

1.2 PERFORMANCE

- A. The corrosion control unit shall be able to provide an ISA 71.04-2013 Contaminant Severity Level G1 classified environment. This will be verified with corrosion classification coupons using copper and silver coupons.

1.3 SUBMITTALS

- A. Submittals shall include the following:
 - 1. Certified shop drawings showing all details of equipment and dimensions.
 - 2. Descriptive literature, bulletins and/or catalogs of equipment including the last five installations of similar equipment.
 - 3. The weight of each major item of equipment.
 - 4. Design loads to the foundation for review and approval prior to fabrication.
 - 5. A bill of materials for equipment.
 - 6. A list of the manufacturer's recommended spare parts. Include gaskets, seals, etc., on the list.
 - 7. Complete data on the head loss for the air flow through the unit at the design air flow rate and at the maximum head loss prior to media change-out.
 - 8. Complete data on the activated carbon showing it to be in conformance with this Section. Include a complete analysis of the capacity of the activated carbon to adsorb hydrogen sulfide and expected life of the carbon in months based on anticipated inlet conditions.
- B. In the event that it is impossible to conform with certain details of this Section, describe completely all non-conforming aspects.

C. Operation and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer. The instructions shall be prepared specifically for this installation and shall include all required catalog cutsheets, drawings, equipment lists, descriptions, etc., that are required to instruct operating personnel that are unfamiliar with such equipment.

1.4 WARRANTY

- A. The manufacturer shall warrant hardware equipment manufactured to be free from defects in material and workmanship under normal use and service for the duration of eighteen (18) months from shipment or twelve (12) months from start-up, whichever occurs first.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The airflow capacity of the unit shall be 1,000 CFM at 3.1-inches WG pressure through prefilters, two stages of media beds and final filters.
- B. The media modules shall contain dry chemical media selected for the application.
- C. The unit shall be model CA-1000, as manufactured by Purafil, Inc., or equal.

2.2 CONFIGURATION

- A. The configuration shall be arranged so that the contaminated air shall flow downward through one pass of particulate filtration, one pass of Purafil PK-12 modules, a blower section, a second pass of Purafil PK-12 modules, and a second pass of particulate filtration before being returned to the room.

2.3 COMPONENTS

- A. The unit shall be a rectangular housing having dimensions of 27 inches (in width x 27 inches in depth x 85 inches in height.
- B. 2 total modules of Purafil's Puracarb media and 2 modules of Purafil's SP blend media.
- C. Each module consists of two 12"x12"x12" media containers.
- D. Direct-drive Blower
- E. Particulate pre-filter

- F. Particulate final filter
- G. Dwyer Series 2000 Magnehelic Pressure Gauge for the prefilter.
- H. Dwyer Series 2000 Magnehelic Pressure Gauge for the final filter.
- I. Altivar 320 variable frequency drive to adjust airflow.
- J. Auto disconnect switch to shut off the unit when the door is opened.

2.4 MATERIALS

- A. The unit's housing shall be fabricated of 14 gauge cold rolled-steel and shall be seam welded.
- B. The unit shall be painted inside and outside using the following procedures:
 - 1. Steam / pressure wash with a paint prep degreaser
 - 2. Epoxy primer coat of no less than 1.5 mils
 - 3. Polyurethane final coat of no less 1.5 mils
- C. Media modules shall be constructed of 0.125" thick, black, high impact polystyrene.
- D. Gasket shall be provided on the CA door and inside of walls, floor, and ceiling.
- E. Sound insulation shall be provided in the blower section.
- F. Housing materials shall be suitable for indoor operation.
- G. Aluminum nameplate with order number and serial number.
- H. All fasteners shall be stainless steel.

2.5 PARTICULATE PRE-FILTER SECTION

- A. General
 - 1. Filters shall be Aerostar® NOVApLeat extended surface pleated air filters as manufactured by Filtration Group or equal.
 - 2. Filters shall be available in standard and high capacity configurations with a depth of 1".
 - 3. Underwriters Laboratories classified to UL 900.
 - 4. Filters are manufactured by an ISO 9001 registered company.
- B. Filter Materials of Construction
 - 1. Media shall be 100% synthetic media that does not support microbial growth.
 - 2. Square pleat tip increases surface contact and increases filter rigidity.

3. Frame shall have a clay coated paper board (1") or high wet strength beverage board (2") with horizontal strips and a vertical support strut in larger sizes on the downstream side that increases filter rigidity and prevents breaching. Frame shall be recyclable.
 4. Filters shall be of a metal-free construction that can be completely incinerated and does not contain galvanized steel to reduce its impact when land-filled.
- C. Filter Performance
1. Filters shall be MERV 8.
 2. Filters shall be rated to withstand a continuous operating temperature of up to 150°F.
 3. Pressure taps and gages shall be installed to permit a local read out of the pre-filter pressure drop.

2.6 PARTICULATE FINAL FILTER SECTION

- A. General
1. Filters shall be Aerostar® GeoPleat mini-pleat air filters as manufactured by Filtration Group or equal.
 2. Underwriters Laboratories classified to UL 900 and ULC-S111-13.
 3. Filters shall be available in a nominal depth of 4".
 4. Filters are manufactured by an ISO 9001 registered company.
- B. Filter Material of Construction
1. Media shall be 100% synthetic gradient dual density media that does not support microbial growth.
 2. Frame shall be constructed with high-impact plastic and impervious to moisture and high humidity.
 3. Media pack shall be adhered to plastic frame on all sides to prevent air by-pass
 4. Filter shall have a hot melt bead separator to maintain pleat pack stability and ensure consistent pleat spacing for optimum air flow.
- C. Filter Performance
1. Filters shall be MERV 11.
 2. Filters shall be rated to withstand a continuous operating temperature of up to 150°F.
 3. Pressure taps and gages shall be installed to permit a local read out of the pre-filter pressure drop.

2.7 BLOWER SECTION

- A. The blower shall be located in the housing between the second and third stages of air cleaning. It has a backward curved, centrifugal, glass reinforced polyamine (GRP) wheel and be direct driven by a 1 HP motor and a variable frequency drive with keypad on door for manual operation. The blower system designed for 0.2-inches of WG external static pressure at the design airflow of 1,000 CFM.

- B. The blower shall sit between 1st and 2nd pass of media internal to the unit with required clearance for service.

2.8 MEDIA BED SECTION

- A. The housing shall contain two chemical media sections, designed to accommodate 12.0" modular media containment devices, utilizing filter tracks.
- B. Modular media containment shall have a nominal size of 24.0" wide x 12.0" high x 12.0" deep in the direction of airflow with a medium bed depth of 3.0". Modules shall be separated into two 12.0" wide x 12.0" high x 12.0" deep sections for ease of installation.
- C. Module shall be factory-filled with selected media.
- D. Pressure drop through each chemical media section shall not exceed 1.3-inches of WG. Maximum airflow velocity through media section shall be 250 feet per minute.
- E. The residence time through the media section shall not be less than 0.24 seconds total - 0.12 seconds per media bed in the direction of airflow. Residence time calculations shall only include media in direct path of air.
- F. Media 1 – 2 total modules of Puracarb media as manufactured by Purafil, Inc. Puracarb media has the following characteristics:

1. Minimum Removal Capacities

Contaminant Gas	g/cc	Weight %
Hydrogen Sulfide (H ₂ S)	0.1440	20.00
Sulfur Dioxide (SO ₂)	0.0720	10.00
Chlorine (Cl ₂)	0.0720	10.00
Nitric Oxide (NO)	0.0187	2.60

2. Density 45 lbs. per cubic ft (+/- 5%)
3. Air Speed up to 250 fpm
4. 99.5% (min) initial removal efficiency

- G. Media 2 – 2 total modules of SP Blend media as manufactured by Purafil, Inc. SP Blend media has the following characteristics:

1. Minimum Removal Capacities

Contaminant Gas	g/cc	Weight %
Sulfur Dioxide (SO ₂)	0.0520	8.13
Nitrogen Dioxide (NO ₂)	0.1434	22.41
Toluene (C ₆ H ₅ CH ₃)	0.0792	12.38

2. Density 45 lbs. per cubic ft (+/- 5%)
3. Air Speed up to 250 fpm
4. 99.5% (min) initial removal efficiency

H. Media must be Non-Hazardous before and after it is spent.

I. All media must be testable for capacity and life.

2.9 INSTRUMENTATION

- A. Differential Pressure: 2 gauges shall be provided with the unit to permit local read-out of pressure drop through the pre-filter and final filter.
- B. Gauges shall be Magnehelic type as manufactured by Dwyer (Series 2000) or approved equal.

2.10 ANALYTICAL SERVICES

- A. Media Sampling and Analysis
 1. The manufacturer shall be able to provide in-house lab analysis for media samples to predict the remaining service life of system media. Media analysis and report shall be provided as needed.

2.11 MANUFACTURER

- A. The manufacturer shall have a minimum of ten (10) year experience in the design, fabrication, and testing of systems that are 99.5+% efficient at removing gaseous contaminants. Only those manufacturers who manufacture and furnish media, which meets the requirements of this specification, shall be accepted.
- B. The manufacturer shall be a single source provider of equipment, media, and testing services and be certified to ISO-9001:2015 standards. ISO certificate must be submitted at time of bid.
- C. Manufacturer shall carry a minimum of \$2,000,000 in Additional Product Liability Insurance to cover any bodily injury or property damage to a third party due to product failure. Evidence of this policy must be submitted at the time of bid.
- D. The manufacturer of this equipment must be the manufacturer of the media and they shall open their manufacturing plant at any time with a forty-eight (48) hour notice to have the owner and engineer supervise the construction of the equipment and media.
- E. The manufacturer shall also manufacture media in their own facility to ISO-9001:2015 standards. Written proof that chemicals and a disc capable

of producing media at their headquarters must be provided. Re-sellers of equipment and media will not be accepted.

- F. Manufacturer shall supply a list of 50 installations of similar capacity to the engineer and owner prior to the bid. All installations must be of dry media type.
- G. The manufacturer shall be Purafil, Inc. or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The corrosion control unit shall be installed by a qualified contractor in strict accordance with the manufacturer's recommendations.

+++END OF SECTION+++

SECTION 15891

DUCTWORK

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of rectangular, round and flat-oval ducts and plenums. The ducts shall be supplied for heating, ventilating and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gage. All systems shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the Fabricator's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any specific material. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the material being furnished. All costs associated with such changes and adjustments shall be included in the price bid for the Work shown and specified.
- C. Related Work Specified Elsewhere:
 - 1. Section 07900, Caulking and Sealants.
 - 2. Section 15050, Basic Mechanical Materials and Methods.
 - 4. Section 15250, Mechanical Insulation.
 - 5. Section 15910, Ductwork Accessories.
 - 6. Section 15990, Testing, Adjusting and Balancing of HVAC Systems.
- D. Definitions:

Sealing Requirements: For the purposes of duct system sealing requirements specified in this Section the following definitions apply:

 - 1. A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 - 2. Joints include girth joints; branch and sub-branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to duct; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.2 SUBMITTALS

Submittals shall be made in accordance with the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Product data including details of construction relative to material, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Sealing materials.
 - 2. Fire-stopping materials.
- B. Shop drawings from duct fabrication shop, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings detailing:
 - 1. Fabrication, assembly and installation details for metal ducts, including plans, elevations, section, details of components and attachments to other Work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Hangers and supports, including methods for building attachment, vibration isolation and duct attachment.
- C. Coordination drawings for ductwork installation shall show the following:
 - 1. Coordination with ceiling suspension members.
 - 2. Spatial coordination with other systems installed in the same space with the duct systems.
 - 3. Coordination of ceiling and wall mounted access doors and panels required to provide access to dampers and other operating devices.
 - 4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- D. Record drawings including duct systems routing, fittings, details, reinforcing, support and installed accessories and devices.

1.3 QUALITY ASSURANCE

Reference Standards: Comply with all Federal and State laws or ordinances, as well as the latest edition of all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. ASTM, American Society for Testing Materials.
- B. ASME, American Society of Mechanical Engineers.
- C. OSHA, Occupational Safety and Health Act.
- D. ANSI, American National Standards Institute.
- E. NFPA, National Fire Protection Association.
- F. UL, Underwriters Laboratories, Inc.

- G. ASHRAE, American Society of Heating, Refrigerating and Air Conditioning Engineers.
- H. SMACNA, Sheet Metal and Air Conditioning Contractors' National Association.
- I. TIMA, Thermal Insulation Manufacturer's Association.
- J. ICBO, International Conference of Building Officials.

1.4 QUALITY STANDARDS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.
- B. Manufacturer shall provide written certification that the equipment provided under this Specification has been designed in accordance with these specifications and is suitable for these service conditions.

1.5 STORAGE AND HANDLING

- A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.
- B. Store and handle sealant fire-stopping materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperature, contaminants or other causes.
- C. Deliver and store stainless steel sheet with mill-applied adhesive protective paper, maintained through fabrication and installation.

1.6 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 METAL DUCT MATERIALS

- A. Provide sheet metal in thicknesses per SMACNA, packaged and marked as specified in ASTM A 700.
 - 1. Aluminum Sheet: ASTM B209, aluminum sheet, alloy 3003-H14. Aluminum

connectors and bar stock shall be alloy 6061-T6, or equivalent strength.

- B. Reinforced shapes and plates, unless otherwise indicated, shall be aluminum reinforcing where installed on aluminum sheet metal ducts.
- C. Tie-rods shall be 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 SEALING MATERIALS

Joint and Seam Sealants: The term sealant used in this Section is not limited to material of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

- A. Joint and Seam Tape: 2-inch wide, glass-fiber-fabric reinforced.
- B. Joint and Seam Sealant: One-part, non sag, solvent-release-curing, polymerized butyl sealant; formulated with a minimum of 75 percent solids.
- C. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- D. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4-inch thick.
- B. Hangers: Galvanized sheet steel or round, uncoated steel, threaded rod.
- C. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
- D. Straps and Rod Sizes: Conform with Table 4-1 SMACNA HVAC Duct Construction Standards for sheet steel width and gage and steel rod diameters.

- E. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger.
- F. Sleeves:
 - 1. Sleeves for round ductwork: Form with galvanized steel.
 - 2. Sleeves for rectangular ductwork: Form with wood or galvanized steel.
 - 3. Size sleeves large enough to allow for movement due to expansion and contraction.
- G. For aluminum provide aluminum support materials, except where materials are electrolytically separated from ductwork.

2.5 RECTANGULAR DUCT FABRICATION

- A. Except as otherwise indicated, fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications and joint types and intervals.
- B. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- C. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains and discoloration.
- D. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:
 - 1. Supply Ducts: 3 inches water gage.
 - 2. Return Ducts: 2 inches water gage, negative pressure.
 - 3. Exhaust Ducts: 2 inches water gage, negative pressure.
- E. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA HVAC Duct Construction Standards, unless they are lined or are externally insulated.

2.6 RECTANGULAR DUCT FITTINGS

Fabricate elbows, transitions, offsets, branch connections and other duct construction in accordance with SMACNA HVAC Duct Construction Standard.

2.8 ROUND AND FLAT OVAL DUCT FABRICATION

- A. Basic round diameter as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given size of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.

Round Ducts: Fabricate round supply ducts with spiral lock seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA HVAC Duct Construction Standards.

2.9 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

- A. 90-Degree Tees and Lateral and Conical Tees: Fabricate to conform to SMACNA HVAC Duct Construction Standards with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, pleated or mitered construction with bend radius of 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:
 - 1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.
 - 2. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA HVAC Duct Construction Standards Table 3-1.
 - 3. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
 - a. 3 to 26 inches: 22 gage.
 - b. 27 to 36 inches: 20 gage.
 - c. 37 to 50 inches: 18 gage.
 - d. 52 to 60 inches: 16 gage.
 - 4. Round Mitered Elbows: Solid welded and with metal thickness listed for pressure classes from 2 inches to 10 inches:
 - a. 3 to 14 inches: 22 gage.
 - b. 15 to 66 inches: 20 gage.
 - c. 27 to 50 inches: 18 gage.
 - d. 52 to 60 inches: 16 gage.
 - e. 62 to 84 inches: 14 gage.
 - 5. Round Elbows - 8 inches and smaller: Die-formed elbows for 45° and 90° elbows and pleated elbows for 30,45,60 and 90 degrees only. Fabricate non-standard bend angle configurations or 1/2-inch diameter (e.g. 3-1/2 and 4-1/2 inch) elbows with gored construction.
 - 6. Round Elbows- 9 through 14 inches: Gored or pleated elbows for 30, 45, 60 and 90 degrees, except where space restrictions require a mitered elbow. Fabricate non-standard bend angle configurations or 1/2-inch diameter (e.g. 9-1/2 and 10-1/2 inch) elbows with gored construction.
 - 7. Round Elbows- Larger than 14 inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
 - 8. Die-Formed Elbows for Sizes Through 8 inches and All Pressures: 20 gage with 2-piece welded construction.

9. Round Gored Elbows Gages: Same as non-elbow fittings specified above.
10. Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.
11. Pleated Elbows Sizes Through 14 inches and Pressures Through 10 inches: 26 gage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Construct and install each duct system for the specific duct pressure classification indicated. Provide openings in ductwork where required to accommodate thermometers and controllers.
- B. Install ducts with fewest possible joints.
- C. Use fabricated fittings for all changes in directions, changes in size and shape and connections.
- D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building line; avoid diagonal runs. Install duct systems in shortest route that does not obstruct usable space or block access for servicing building and its equipment.
 1. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partition, except as specifically shown.
 2. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
 3. Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Provide clearance of 1-inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- H. Install insulated ducts with 1-inch clearance outside of insulation.
- I. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.2 SEAM AND JOINT SEALANT

Seal duct seams and joints as follows:

- A. Pressure Classifications Greater than 3 Inches Water Gage: All transverse joints, longitudinal seams and duct penetrations.
- B. Pressure Classification 2 and 3 Inches Water Gage: All transverse joints and longitudinal seams.
- C. Pressure Classification Less than 2 Inches Water Gage: Transverse joints only.
- D. Seal externally insulated ducts prior to insulation installation.

3.3 HANGING AND SUPPORTING

- A. Install rigid, round, rectangular and flat oval duct with support systems indicated in SMACNA HVAC Duct Construction Standards.
 - 1. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
 - 2. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- B. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.
- C. Install concrete insert prior to placing concrete.
- D. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.4 CONNECTIONS

- A. Connect equipment with flexible connectors in accordance with Section 15910 Ductwork Accessories.
- B. All duct connections shall comply with SMACNA HVAC Duct Construction Standards.

3.5 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Adjustments shall be in accordance with Section 15990 Testing, adjusting and balancing air systems.
- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

+++ END OF SECTION +++

SECTION 15910

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of all ductwork accessories. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.
- C. Types of ductwork accessories required for project include the following:
 - 1. Low Pressure manual dampers.
 - 2. Turning vanes.
 - 3. Duct hardware.
 - 4. Duct access doors.
 - 5. Flexible connections.
 - 6. Supply diffusers.
- D. Related Work Specified Elsewhere:
 - 1. Section 15050, Basic Mechanical Materials and Methods.
 - 2. Section 15891, Ductwork.
 - 3. Section 15990, Testing, Adjusting and balancing of HVAC Systems.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Product Data. Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
 - a. Schedule of air outlets and inlets indicating drawing designation, room

- location, number furnished, model number, size, and accessories furnished.
 - b. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 - c. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
2. Manufacturer's assembly-type drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- B. Maintenance Data. Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of General Conditions of the Contract Documents.

1.3 QUALITY ASSURANCE

Reference standards. Comply with all Federal state laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. SMACNA Compliance. Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
- B. Industry Standards. Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
- C. UL Compliance. Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
- D. NFPA Compliance. Comply with applicable provisions of NFPA 90A "Air conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.
- E. ADC Compliance. Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
- F. ADC Seal. Provide air outlets and inlets bearing ADC Certified Rating Seal.
- G. AMCA Compliance. Test and rate louvers in accordance with AMCA 500 Test Method for louvers, Dampers and Shutters."
- H. AMCA Seal. Provide louvers bearing AMCA Certified Rating Seal.

1.4 QUALITY STANDARDS

- A. All ductwork accessories shall be furnished by a single manufacturer who shall assume sole responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings.
- B. Manufacturer shall provide written certification that the equipment provided under this Specification has been designed in accordance with these specifications and is a suitable application for these service conditions.
- C. Manufacturer's offering products that comply with these specifications include:
 - 1. Dampers:
 - a. Air Balance, Inc.
 - b. Airguide Corp. American Warming & Ventilating, Inc.
 - c. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
 - d. Louver & Dampers, Inc.
 - e. Penn Ventilator Co.
 - f. Ruskin Mfg. Co.
 - g. Or equal.
 - 2. Turning Vanes:
 - a. Aero Dyne Co.
 - b. Airson Corp.
 - c. Barber-Colman Co.
 - d. Duro Dyne Corp.
 - e. Environmental Elements Corp.; Subs. Koppers Co., Inc.
 - f. Souther, Inc.
 - g. Hart & Cooley Mfg. Co.
 - h. Or equal.
 - 3. Duct Hardware:
 - a. Ventfabrics, Inc.
 - b. Young Regulator Co.
 - c. Or equal.
 - 4. Duct Access Doors:
 - a. Air Balance Inc.
 - b. Duro Dyne Corp.
 - c. Register & Grille Mfg. Co., Inc.
 - d. Ruskin Mfg. Co.
 - e. Ventfabrics, Inc.
 - f. Zurn Industries, Inc.; Air Systems Div.
 - g. Or equal.
 - 5. Flexible Connectors:
 - a. American/Elgen Co.; Energy Div.

- b. Duro Dyne Corp.
 - c. Flexaust (The) Co.
 - d. Ventfabrics, Inc.
 - e. Or equal.
- 6. Supply Diffusers:
 - a. Titus.
 - b. Anemostat.
 - c. Carnes.
 - d. Price
 - e. Or equal.

1.5 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.1 DAMPERS

- A. Low Pressure Manual Dampers. Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards." Volume dampers shall be provided with recommended size quadrants per SMACNA standard. Where ductwork is externally insulated provide quadrants on a stand off so that they are accessible.

2.2 TURNING VANES

- A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".
- B. Manufactured Turning Vanes: Provide turning vanes constructed of 1-½-inch wide curved blades set at ¾-inch o.c., supported with bars perpendicular to blades set at 2-inches o.c., and set into side strips suitable for mounting in ductwork.
- C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusions with perforated faces and fiberglass fill.

2.3 DUCT HARDWARE

- A. General. Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
- B. Quadrant Locks. Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
- C. Test holes. Provide in ductwork at fan inlet and outlet and elsewhere as required, duct test holes, consisting of slot and cover for instrument tests.

2.4 DUCT ACCESS DOORS

- A. General. Provide access doors where fire dampers or motorized dampers are installed in ductwork.
- B. Construction. Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

2.5 FLEXIBLE CONNECTIONS

- A. General. Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.6 SUPPLY DIFFUSERS

- A. Provide supply diffusers where shown in the ductwork.
- B. Type: Square, adjustable pattern, stamped, multi-core diffuser to discharge air in 360 degree with sector baffles where indicated.
- C. Frame: Inverted T-bar type.
- D. Fabrication: Aluminum with #26 white baked enamel finish. Paint shall pass a 100-hour ASTM B117 Corrosive Environment Salt Spray Test.
- E. Manual balancing damper for installation in the branch duct.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 45 and 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.
- C. Install access doors with operable latches.
- D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.
- E. Locate diffusers, registers, and grilles, as indicated on Mechanical Drawings.

3.3 SPARE PARTS

- A. Furnish to Engineer, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

3.4 FIELD QUALITY CONTROL

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.5 ADJUSTING AND CLEANING

- A. Adjusting. Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action. Final positioning of manual dampers is specified in Division 15, Section 15990, Testing, Adjusting, and Balancing.
- B. Cleaning. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

+++ END OF SECTION +++

SECTION 15950

HVAC CONTROLS

PART 1 - GENERAL

1.1 SCOPE

- A. Extent of electric control systems work required by this Section is indicated on drawings and schedules, and by requirements of this Section. Control sequences are specified in this Section.
- B. Refer to other Division-15 Sections for installation of manual volume dampers in mechanical systems.
- C. All work shall be in compliance with the National Electrical Code.
- D. Refer to Division-16 Sections for the following work:

Power supply wiring for power source to control panels, starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
- E. Furnish control and interlock wiring under this section between field installed controls, indicating devices, motorized damper operators and unit control panels in compliance with the requirements of Division 16.
- F. Control panel enclosures, starters, and disconnect switches shall be furnished under this section in accordance with the requirements specified under Division 16.

1.2 SUBMITTALS.

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Product Data: Manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.
 - 2. Schematic flow diagram of system showing fans, dampers, and control devices.
 - 3. Label each control device with setting or adjustable range of control.
 - 4. Control interlock wiring diagrams. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
 - 5. Details of faces of control panels, including controls, instruments, and labeling.
 - 6. Written description of sequence of operation.

7. Wiring diagrams.
8. Operation and maintenance manuals.

1.3 QUALITY ASSURANCE.

- A. Manufacturer's Qualifications. Only firms regularly engaged in the manufacture of electric control equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years shall be eligible to provide and install the equipment specified herein.
- B. Codes and Standards.
 1. Electrical Standards. Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.
 2. NEMA Compliance. Comply with NEMA standards pertaining to components and devices for electric control systems.
 3. NFPA Compliance. Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.4 QUALITY STANDARDS

- A. Manufacturer. Subject to compliance with requirements, provide electric control systems of one of the following.
 1. Honeywell, Inc.
 2. Johnson Controls, Inc.
 3. Siemens
 4. Or equal.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to protect equipment from dirt and moisture. Store equipment and materials inside and in original shipping packaging.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT.

- A. General. Provide electric control products in sizes and capacities indicated, consisting of dampers, thermostats, sensors, controllers, and other components as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard

control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide electric control systems with the following functional and construction features as indicated.

- B. Electric Contactors: Provide contactors for operating or limit control of electric heating loads which are UL-listed for 100,000 cycles of resistive loads. Equip with replaceable molded coils and replaceable silver cadmium oxide contacts. Coat core laminations with heat-resistant inorganic film to reduce core losses. Provide line and load terminals on contactors with higher-than-35-amp rating, or provide one-piece formed-and-welded pressure type. Provide screw-type contactors for 35-amp-or-lower rating. Equip field-mounted contactors with suitable steel enclosures; and provide open-type mounting for those installed in factory-fabricated panels.
- C. Control Wiring: All control, interlock and starting circuit wiring, except where otherwise specified or noted on the plans, is to be furnished under this Section.
 - 1. Line voltage wiring shall not be smaller than #14, 600-volt wire. All wire shall be run in conduit with outlet boxes and fittings in compliance with the requirements of Division 16, Electrical.
 - 2. 24-volt wiring shall be not less than #18 gauge, with 600-volt insulation. Wiring run in partitions or above ceilings shall be run in plenum rated cable.
 - 3. Control voltage shall not exceed 120 volts. Provide transformers and relays to comply with this requirement.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

- A. General. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 Sections of these specifications. Mount controllers at convenient locations and heights.
- B. Control Wiring. The term "control wiring" is defined to include provision of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- C. Wiring System. Install complete control wiring system for electric control systems.

Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

- D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

3.3 ADJUSTING AND CLEANING.

- A. Start-Up. Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Cleaning. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment. After completion of installation, adjust thermostats, damper operators, motors and similar equipment provided as work of this Section. Final adjustment shall be performed by specially trained personnel in direct employ of the manufacturer of primary temperature control system.

3.4 CLOSEOUT PROCEDURES

- A. City's Instructions: Provide services of manufacturer's technical representative for four hours to instruct City's personnel in operation and maintenance of electric control systems. Schedule instruction providing at least 7-days of notice for training date.

3.5 SEQUENCE OF OPERATION

- A. Electric Building - Air Conditioning System (ACU-1/ACC-1)
 - 1. When the unit's ON/OFF switch is in OFF position, the unit shall be off.
 - 2. When the switch is in ON position, the AC unit shall run with its own factory furnished controls to maintain the space temperature set point of 80°F (adjustable) for cooling.
 - 3. When the space temperature goes above the space high temperature set point of 90°F (adjustable), a high temperature alarm shall be activated for remote reporting at the HMI.
 - 4. If the smoke is detected by the factory mounted smoke detector, the unit shall be shut down and smoke detection alarm shall be reported at the HMI.
 - 5. If the AC unit goes into fault mode for any reason, a common fault alarm shall be generated, and it shall be reported at the HMI.
- B. Electric Building - Heating System (EUH-1 and EUH-2)).

1. The space electric unit heaters shall operate with their own factory furnished thermostats and controls to maintain the space at 55°F (adjustable) when space heating is required.

C. Electric Building - Corrosion Control Unit (CCU-1).

1. When the units ON/OFF switch is OFF, the unit's blower shall be off.
2. When the switch is in ON position, the blower shall run to circulate the room air through the activated carbon media to scrub the corrosive gases from the air.

+++ END OF SECTION +++

SECTION 15990

TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section specifies the requirements and procedures for HVAC systems testing, adjusting and balancing. Requirements include measurement and establishment of the fluid quantities of the HVAC systems as required to meet design specifications, and recording and reporting the results.
- B. The Contractor shall procure the services of an independent air balance and testing agency, who is a current member in good standing of the Associated Air Balance Council (AABC), approved by the Engineer and who specializes in the testing, balancing and adjusting of heating, ventilating and air conditioning systems. The agency shall be certified by the National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project and having at least one Professional Engineer registered in the State in which the services are to be performed and certified by NEBB as a Test and Balance Engineer.
- C. Test and balance all HVAC systems including the following:
 - 1. Supply air systems
 - 2. Return air systems.
 - 3. Verify temperature control system operation.
- D. Test systems for proper sound and vibration levels.
- E. Related work specified elsewhere:
Section 15950, HVAC Controls.
- F. Definitions:
 - 1. Systems testing, adjusting and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:
 - a. The balance of air distribution.
 - b. Adjustment of total system to provide design quantities.
 - c. Electrical measurement.
 - d. Verification of performance of all equipment and automatic controls.
 - e. Sound and vibration measurement.
 - 2. Test: To determine quantitative performance of equipment.
 - 3. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment.
 - 4. Balance: To proportion flows within the distribution system (submains, branches and terminals) according to specified design quantities.

5. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
6. Report forms: Test data sheets arranged for collecting data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting and balancing.
7. Terminal: The point where the controlled fluid enters or leaves the distribution system. There are supply outlets on air terminals and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers and hoods.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the General Condition of the Contract Documents. In addition, the following specific information shall be provided:
 1. Submit testing agency's name for approval; include resume of at least ten similar projects including testing dates, project name, system description and contractor.
 2. Name of certified Test and Balance Engineer assigned to supervise the procedure and the technicians proposed to perform the procedures.
 3. Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed for the project.
 4. Maintenance and operating data that includes how to test, adjust and balance the building systems.
 5. Copies of test reports intended for use.
- B. Preconstruction Plan Check and Construction Review.
 1. The Contractor is to insure that the testing agency is provided with up-to-date Contract Documents and all Contractor submittals related to the Work required by this Section.
 2. Provide a preconstruction plan check in accordance with the procedure specified in the referenced standards. Submit a written report of the plan check to the Engineer for review prior to commencement of HVAC Systems installation.
 3. Provide periodic construction review during the progress of related HVAC systems installation in accordance with the procedures specified in the referenced National Standards.
- C. Pre-TAB Checklist
Prior to the Testing, Adjusting and Balancing (TAB) Work for any HVAC system, submit a completed AABC "Systems Ready to Balance Checklist" to the Engineer for records. The Contractor is to insure that all work is complete and ready for TAB.
- D. Certified Reports: Submit testing, adjusting and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted and balanced in accordance with referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures

and format specified below:

1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Organize and format draft reports in the same manner specified for the final reports (drafts may be handwritten). Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
2. Final Reports: Upon verification and approval of draft reports, prepare final reports, type written and organized and formatted as specified in Paragraph 2.1. Submit 2 complete sets of final reports.
3. Calibration reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as the latest edition of all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 1. ASHRAE, American Society of Heating, Refrigerating and Air Conditioning Engineers- Fundamental Handbook, Ch. 13; System and Application Handbook, Ch. 57.
 2. SMACNA, Sheet Metal and Air Conditioning Contractors' National Association- Testing, Balancing and Adjusting of Environmental Systems; HVAC Systems.
 3. AABC, Associated Air Balance Council- National Standards for Total System Balance.
 4. NEBB, National Environmental Balancing Bureau- Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
- B. The testing agency shall be the single source of responsibility to test, adjust and balance the HVAC systems and produce the design objectives.

1.4 SEQUENCING AND SCHEDULING

- A. Test, adjust and balance air conditioning systems before refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5° F wet bulb temperature of maximum summer design condition, and within 10°F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide all necessary TAB devices, instrumentation, test equipment, electricity, HVAC

system accessories and specialties required to accomplish the Work specified in this Section. The Contractor is responsible for the proper placement of such items in the HVAC system.

B. Certified TAB Report.

1. Report forms shall be standard forms as prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Bind report forms, complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the following divisions:
 - a. General Information and Summary
 - b. Air Systems
 - c. Temperature Control Systems
 - d. Sound and Vibration Systems
2. Certification Form shall include most current date on Contract Documents.
3. The certified test report shall include, but not be limited to, the following Forms and Test Reports:
 - a. Instrument list form.
 - b. Air moving equipment test report shall include the additional information:
 - 1) Design and operating motor brake-horsepower.
 - 2) Manufacturer's fan curve with design and operating points plotted.
 - 3) Operating voltage and amperage.
 - 4) Motor starter heater element sizes.
 - c. Static pressure profile form.
 - d. Air terminal test forms.
 - e. Rectangular duct traverse report.
 - f. Round duct traverse report.

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

Before operating the system perform the following steps:

- A. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
- B. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return and exhaust) and temperature control diagrams.
- C. Compare design to installed equipment and field installations.
- D. Walk the system from the system air handling equipment to terminal units to determine

variations of installation from design.

- E. Check filter for cleanliness.
- F. Check dampers (both volume and fire) for correct and locked position and temperature control for completeness of installation before starting fans.
- G. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a cross-check with required fan volumes.
- H. Determine best locations in main and branch ductwork for most accurate duct traverses. Place outlet dampers in the fully open position.
- I. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

3.2 MEASUREMENTS

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage. Take all measurements in the system where best suited to the task.
 - 1. Instruments shall meet the specifications of the referenced standards.
 - 2. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
 - 3. Apply instrument as recommended by the manufacturer.
- B. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- C. Take all readings with the eye at the level of the indicated value to prevent parallax.
- D. Use pulsation dampeners where necessary to eliminate error involved in estimating averages of rapidly fluctuating readings.

3.3 TESTING, ADJUSTING AND BALANCING

- A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
 - 1. Cut insulation, ductwork and piping for installation of test probes to the minimum extent possible to allow adequate performance of procedures.
 - 2. Patch insulation, ductwork and housings using materials identical to those removed.
 - 3. Seal ducts and piping, and test for and repair leaks. Seal insulation to re-establish

- integrity of the vapor barrier.
 - 4. Mark equipment settings, including damper control position, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
 - 5. Retest, adjust and balance systems subsequent to significant system modifications and resubmit test results.
- B. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.
- C. Adjust all HVAC systems to deliver the specified air quantities within the following tolerances:
- 1. Equipment (fans, heat transfer equipment, and air terminal units). $\pm 10\%$.
 - 2. Air outlets. $\pm 10\%$.

3.4 RECORD AND REPORT DATA

- A. Record all data obtained during testing, adjusting and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.
- B. Prepare report of recommendations for correcting unsatisfactory performances when system cannot be successfully balanced.

3.5 DEMONSTRATION

- A. Submit the final TAB report for review along with Contractor's completed checklist of recommendations for correcting unsatisfactory areas identified by testing agency.
- B. Pre-test all systems prior to inspection and acceptance tests required by referenced standards. Provide detailed documentation of the referenced standard inspection tests by the Contractor and include test procedures, participants, dates and times, instruments used, test data and a summation of test results. Submit test reports prior to system commissioning tests conducted by the City.
- C. System Commissioning Tests.
 - 1. Tests shall demonstrate that capacities and general performance of air systems comply with Contract requirements.
 - 2. At the time of system commissioning, recheck, in the presence of the Engineer, random selections of data (air quantities and air motion) recorded in the certified TAB test report.
 - 3. Selections for checks in general will not exceed 25 percent of the total number tabulated in the report.
- D. Train the City's maintenance personnel on troubleshooting procedures and testing, adjusting and balancing procedures. Review with the City personnel the information contained in the Operating and Maintenance Manual.

- E. Schedule training with City with at least 7 days prior notice.

3.6 SERVICES

- A. Retests. If random tests elicit a measured flow deviation exceeding the specified tolerances, the TAB report will automatically be rejected. In the event the report is rejected, readjust and test all systems, record new data, submit new certified Reports and perform new rechecks at no additional cost to the City; including time required by the Engineer.
- B. Reinspection. TAB Agency shall make 2 return inspection trips to the project, one during heating design conditions and one during air conditioning design conditions for the purpose of checking out the entire system or group of systems.
- C. Readjustments. Balancing agency shall make additional adjustments required during the reinspection.

+++ END OF SECTION +++

SECTION 16000

ELECTRICAL POWER AND SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete installation of all electrical power and systems. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

1.2 DEFINITIONS

- A. Provide: Furnish, install, and connect
- B. Product Data: Catalog cuts and descriptive literature
- C. Shop Drawings: Factory prepared specific to the installation
- D. Indicated: Shown on the Contract Drawings
- E. Noted: Indicated or specified elsewhere
- F. Control Diagram: A control diagram shows by means of graphic symbols, the electric connections and functions of a specific circuit arrangement. The control diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
- G. One-Line Diagram: A one-line diagram shows by means of single lines and graphic symbols the course of an electric circuit or system of circuits and the components, devices, or parts used therein. Physical relationships are usually disregarded.

- H. Block Diagram: A block diagram is a portrayal of a system, instrument, computer, or program which selected portions are represented by annotated boxes and interconnecting lines.
- I. Wiring Diagram: A wiring or connection diagram includes all the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. This diagram shall be a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or b) a panel layout drawing showing the physical location of devices plus the control diagram.
- J. Interconnection Diagram: Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagram. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the individual wires clearly shown. Wireless diagrams and wire lists are not acceptable. Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified. All jumpers, shielding and grounding terminations not shown elsewhere shall be shown here. Signal and DC circuit polarities shall be shown. Spare wires shall be shown.
- K. Arrangement, Layout, or Outline Drawings: An arrangement, layout, or outline drawing is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements or the location to which connections are to be made.

1.3 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Information required "for reference" such as product samples, similar unit test reports, and time current curves is for the purpose of determining the suitability of a product, selecting breaker settings, etc. This information is to be submitted at the same time as approval data; however, this information will not be returned and stamped approval is not required prior to installation.
- B. Except as noted, installation instructions are not required to be submitted. However, it is the Contractor's responsibility to obtain installation information from the manufacturer for all equipment prior to installing the equipment.
- C. Interconnecting diagrams depicting all cable requirements together with actual terminations as specified under paragraph 1600-1.2J.

1.4 QUALITY ASSURANCE

- A. Provide complete electrical installation in accordance with the National Electrical Code (NFPA 70), Life Safety Code (NFPA 101), Standard for Electrical safety in the Workplace (NFPA 70 E), and in accordance with applicable local codes. Obtain all necessary permits and have all work inspected by appropriate authorities.
- B. All products shall be designed, manufactured, and tested in accordance with industry standards. Where applicable, products shall be labeled or listed by third party certification agencies.
- C. Industry Standards: Standards organizations and their abbreviations, as used herein, are as follows. Applicable date for industry standards is that in effect on the date of advertisement of the project.
 - 1. American National Standards Institute (ANSI).
 - 2. American Society for Testing and Materials (ASTM).
 - 3. Federal Specifications (FS).
 - 4. Institute of Electrical and Electronics Engineers (IEEE).
 - 5. Insulated Cable Engineers Association (ICEA).
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. National Fire Protection Association (NFPA).
 - 8. Underwriters Laboratories, Inc. (UL).
 - 9. National Electrical Testing Association (NETA).

1.5 WORK PROVIDED OUTSIDE THIS CONTRACT

When indicated on drawings.

1.6 WORK INCLUDED IN DIVISION 16, ELECTRICAL

- A. Electrical power and systems.
- B. Basic materials and methods.
- C. Conduit.
- D. Conductors.
- E. Boxes.
- F. Wiring devices.
- G. Electric motors.
- H. Cabinets and enclosure.
- I. Instrument transformers and meters.

- J. Surge arrestors
- K. Surge Protection devices
- L. Disconnect switches.
- M. Grounding.
- N. Low voltage control center.
- O. Low voltage variable frequency drive.
- P. Lighting Luminaires
- Q. Telephone system.
- R. Acceptance testing and calibration.
- S. Access system.
- T. Materials and equipment furnished and installed under other Divisions with raceway and electrical conductors furnished, installed, and connected under Division 16, Electrical.
- U. Equipment, Instrumentation and control system components indicated on the Drawings by filled circumscribed diamond symbol.

1.7 INTENT OF DRAWINGS

Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned. The Contractor shall be responsible for proper routing of raceway, subject to the approval of Engineer.

1.8 ARC SHORT CIRCUIT AND ARC FLASH RATINGS

Match existing short circuit ratings and Arc Flash labels for any circuit breaker, disconnect or control panel replaced or added under this contract.

1.9 ELECTRICAL NUMBERING SYSTEM

- A. Raceway Numbers:
 - 1. Raceways shall be tagged at all terminations. where raceway numbers have not been assigned, Contractor shall assign raceway numbers in accordance with the following system:

Raceway Prefix	Type of Function
C	Control and/or 120V or less power
H	Power above 600V
N	Pneumatic tubing
P	Power 208V to 600V
S	Low level signal (less than 90 volt communication or less than 30 volt instrumentation)
X	Spare

2. Prefixes shall be followed by a 5-digit equipment number. Where there is more than one raceway to a particular equipment, a letter suffix is added to distinguish the raceways.
3. Example:

Raceway number = P31109A

31109 = unique 5-digit equipment number

A = Letter to distinguish from other raceways to same equipment

B. Conductor Numbers:

1. Conductors shall be identified with numbers at both ends. Conductor tag numbers shall consist of the 5-digit equipment number followed by a dash followed by the conductor number specified on the control diagram.
2. Example:

Tag number = 19000-L1

Where:

19000 = Cable number

L1 = Conductor number

3. Conductors which are in parallel or in series between equipment shall have the same conductor number. Neutral conductors shall have the same conductor number. wherever possible, the conductor shall be the same as the terminal to which it connects.

4. When factory-wired equipment has terminal numbers different than the conductor number shown on the control diagram, both shall be shown on the interconnection diagram, and a copy of the interconnection diagram shall be fastened to the inside of the equipment cabinet.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Ship products to the job site in their original packaging. Receive and store products in a suitable manner to prevent damage or deterioration. Keep equipment upright at all times.
- B. Investigate the spaces through which equipment must pass to reach its final destination. Coordinate with the manufacturer to arrange delivery at the proper stage of construction and to provide shipping splits where necessary.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide only new products of the manufacturer's latest design.
- B. Equipment shall be applied only within its rating. Equipment ratings shown are minimums. Voltage and current ratings shall be as required to adequately power the connected equipment. Fault current ratings shall be as shown for the particular item or for the next upstream device that has a fault current rating shown.
- C. Shall be approved by national laboratory and listed as adequate for the classified hazardous areas as indicated on the drawings.
- D. The corrosive areas are as indicated in schedule on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Maintain continuity of electric service to all portions of the process or buildings at all times. Temporary outages will be permitted during cutover work at such times and places as can be prearranged with the City of Atlanta, the Engineer, and the electric utility company providing service to the facility. Such outages shall be kept to a minimum number and minimum length of time. Make no outages without prior written authorization from the City of Atlanta.. Include all costs for temporary

wiring and overtime work required in the Contract price. Remove all temporary wiring at the completion of the work.

- B. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.
- C. Unless otherwise indicated, all material required to be removed and salvaged shall become the property of the City.
- D. Carefully modify existing electrical equipment, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

3.2 CERTIFICATION AND TESTS

- A. Prior to request for final review, test all systems and repair or replace all defective work. Submit, with request for final review, written certification that all electrical systems are complete and operational.
- B. At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for systems' demonstration.
- C. After final review and acceptance, turn over to the Engineer all keys for electrical equipment locks. Present to the City's designated representatives, demonstrations and oral instructions for proper operation and maintenance of the electrical equipment and systems.

END OF SECTION

SECTION 16100

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

See General conditions for submittal requirements. Drawings and general provisions of Contract, including General Conditions and Division 1 specification sections, apply to work of this section.

1.2 QUALITY CRITERIA:

Applicator shall be qualified to perform required task.

1.3 INTERRUPTION OF SERVICE:

- A. Power service interruptions shall be done only with the written permission of the City of Atlanta at times so designated by the City.
- B. Coordinate shutdowns of temporary power systems with other contractors so as not to delay completion of their work. Prepare to work continuously including required overtime when required, to restrict power shut down period to an absolute minimum.
- C. Provide to the City in written notice in advance of any required shutdown. Make requests for shutdown in writing at least four consecutive calendar days in advance of the anticipated shutdown date.

1.4 COMPLETENESS OF WORK:

Provide all boxes, offsets, bends, raceways, raceway supports, fittings and wiring for the complete installation. Provide all components to complete the systems specified. Each unit of equipment shall be completely assembled and installed, and all surfaces shall be clean and free from dents, scratches, abrasions or marred areas.

1.5 LOCATION OF OUTLETS:

- A. Outlets for lighting, power and equipment, not specifically dimensioned are located diagrammatically on the drawings. Luminaires shall be located in accordance with reflected ceiling plans or tile pattern outlines. If neither is indicated, Luminaires shall be symmetrical within the space in which they are located. Reference shall be made to the architectural,

mechanical and fire protection plans and to the shop drawings of the equipment to be installed for the exact location of the outlets. Power outlets shall be located so as to serve the equipment directly. Where new or future furniture, equipment or in built casework is indicated on Architectural plans, outlet height and position shall be coordinated by the Contractor to assure accessibility of the outlet.

- B. Outlet location: May be moved 10 feet in any direction before being installed, without additional cost to the owner.

1.6 ENCLOSURES

A. Area Classifications:

1. Materials, equipment, and incidentals shall be suitable for the area classification(s) shown, specified, and required.
2. Indoor Locations: Indoor areas designated as electrical rooms and not designated as hazardous, corrosive, or wet locations. Comply with NEC and NEMA 1 requirements unless specified otherwise.
3. Outdoor Locations: All enclosures located outdoors shall be 316 SS and comply with NEMA 4X.
4. Hazardous Locations: Comply with NEC requirements for the Class and Division designated.
5. Dusty Locations: Indoor areas not designated as hazardous, corrosive, or wet are dusty locations. Comply with NEC and NEMA 12 requirements unless specified otherwise.

1.7 MOTORS, STARTERS AND CONTROL DEVICES:

Generally all individually mounted motor control devices will be furnished by other divisions. Where such devices are indicated on electrical drawings Division 16 Contractor shall receive device and install it complete including line and load side connections to equipment.

PART 2 - PRODUCTS

2.1 SLEEVES, OPENINGS AND FIRESAFING:

- A. Exterior non membrane openings: Provide cast iron pipe sleeves for conduits passing through non membrane waterproofed exterior walls, footings, roofs or beams. Sleeves through exterior walls below grade shall have continuously welded center flange buried in construction. Make conduit watertight in sleeve with oakum packing and caulked lead joints on both sides of wall.

- B. Interior membrane openings: Provide cast iron sleeves passing through interior membrane waterproofed floors with integral flashing flange and clamping ring, similar to Josam Series #1880. Adjust sleeves to floor construction with galvanized steel or wrought iron pipe nipples top and bottom, extending two inches above finished floor. Securely clamp sleeve to flashing with clamping device.
- C. Exterior membrane openings: Provide cast iron sleeves passing through exterior membrane waterproofed walls, floors and roof with integral flashing flange and clamping ring, similar to Josam Series #1870 modified for required thickness. Make conduit watertight in sleeve with oakum packing and caulked lead joint.
- D. Fire rated assemblies: Sleeves in slabs or in fire rated walls shall be packed with incombustible compound and caulked at ends with an incombustible compound. Provide a watertight seal at top of sleeves in slab. Seal of excess areas of floor openings around conduit and cable risers at each floor slab with a compound similar to Chase Form CTC PR 855. Provide fire safing construction which has the same fire rating as the work penetrated.
- E. In electrical and mechanical rooms sleeves: Set sleeves with their top end set at least eight inches above finished floor. In addition, where sleeves pierce slabs or walls separating Machine Room Areas from Office Areas or other quiet areas, sleeves shall be packed with Fiberglass insulation to prevent noise transfer.
- F. Provide flashing fittings for passing through roofs, Josam 1840 or 1830 or approved equal set at a suitable level above the roof to terminate the base flashing. Arrange conduit passing through the roofs to be a minimum of twelve inches from walls or other obstruction so as to permit proper flashing.

2.2 CONDUIT AND EQUIPMENT SUPPORTS:

- A. Exposed conduit: Securely fasten in place by means of approved supports and fastenings and install with threaded fittings or types adaptable for the particular location. Hang no electric conduits on hangers with any other service and hang above all other service pipes unless otherwise shown on the contract drawings. Do not support conduit from ductwork, piping, equipment, etc.
- B. Vertical support: Support vertically run conduits of less than 2" trade size at intervals not exceeding eight feet. Support such conduits, 2" trade size or larger, at intervals not greater than story height, or fifteen feet, whichever is smaller. Support conduits on heavy steel clamps bolted

tightly around the conduits and anchored securely to the building structure without blocking.

- C. Horizontal conduits: Securely fasten conduits in place at not more than ten foot centers, and hangers, supports or fastenings shall be provided at each elbow, at the end of each straight run.
- D. Conduit in hung ceilings: Adequately support conduits by means of clamps, pipe straps or clamps designed to support conduit the structural members supporting the ceiling or to the structural slab or to the building's structural steel in the event that the ceiling system has not been installed sufficiently in advance of the conduit installation. Where feeder conduit or more than one branch conduit are installed adjacent to each other the conduit shall be supported on channels with conduit clamps mounted from the building's structural system.
- E. Additional hangers: Provide at concentrated load points such as heavy equipment and pull boxes branch connections, for conduit four inches and larger, to limit conduit sag to 0.1 inch between supports.
- F. Provide supporting frames or racks for work indicated as being supported from walls. Provide such frames or racks in electric and telephone closets. No work intended for surface installation in damp locations shall be mounted directly on any wall. In such locations, flat bar members or spacers shall be used to create a minimum 1/4" air space between the walls and the work. Include in the electrical work channel sills for leveling and support of all floor mounted electrical equipment.
- G. Luminaires: Support from supplemental steel attached to suspended ceiling horizontal support members or directly from the building's structural slabs or steel utilizing machine bolt expansion anchors and/or beam clamps. Fluorescent Luminaires shall be secured in place with a wire hanger at each corner, or with Luminaire clips specifically designed to secure Luminaire to the ceiling grid members.
- H. Multiple hangers: Design to support a load equal to the sum of the weights of the equipment of conduits and contents, the weight of the hanger itself, plus 200 pounds. Hanger rods shall be hot dipped galvanized. Utilize single or multiple hangers as appropriate. Provide threaded rods not less than 1 1/2 inches of adjustment. Chains, wood, wire or perforated strapping shall not be used for hanging conduit or equipment.
- I. Unenclosed wiring: Secure wiring in ceiling space to the structure with attachments designed for that purpose.

2.3 PRIMING AND PAINTING:

- A. Painting: Each electrical enclosure including but not limited to switchboards, panelboards, cabinets, motor control centers, motor controllers, disconnects, wireways and similar enclosures shall be provided with a factory finish of not less than two coats of the manufacturer's standard color. Any finishes scratched or marred during construction shall be touched up to the satisfaction of the Architect prior to final inspection.
- B. Priming: The requirements for prime painting apply only to ferrous metal materials furnished under this Section and having no factory finish, and to plywood boards. Metal surfaces shall be thoroughly cleaned of all loose rust and scale, oil, grease, or other foreign substances. Surfaces shall then be given two coats of primer. Plywood surfaces shall be given two coats of fire retardant paint.

2.4 BACK UP BOARDS:

- A. Where telephone cabinets or, where two or more pieces of equipment such as safety switches, motor controllers, timers and contactors are installed in one location, provide a panel of five (5) ply three fourth (3/4) inch thick softwood face plywood with one side finished and painted black on all sides. Plywood sizes large enough to accommodate the equipment or devices to be attached thereto. Panel shall be attached to the wall or metal frame. Plywood shall have fire retarding properties.
- B. Telephone terminal boards: Provide plywood same as above and approximately 8 feet tall with horizontal dimension approximately as indicated to scale on drawings. Bottom of board shall be 12" above finished floor.

2.5 GROUNDING MATERIALS AND METHODS:

- A. Ground rods: Provide copper, 3/4 inch diameter and no less than 10 feet long. Rods shall be driven such that their tops are one foot (minimum) below finished grade.
- B. Grounding conductors: Provide within the building a conductor that is insulated and installed in raceway. At all points where grounding conductors enter or leave metal raceway they shall be bonded thereto. Where length of metal conduit is 5' 0" or less, bonding at one end is sufficient. Grounding conductors outside the building shall be bare, directly buried two feet (minimum) below finished grade with a non corroding runner tape one foot above the conductor the entire length.
- C. Buried connections in the grounding system and connections of grounding conductors to structural columns shall be by the Cadweld process. Other connections shall be by means of UL approved clamp type connectors.

2.6 EQUIPMENT GROUND:

- A. Frames and metal enclosures: Connect all electrical equipment to the equipment ground system. All raceways shall be provided with a green grounding conductor. Conductors shall be sized in accordance with Table 250-95 of the National Electrical Code or larger where so indicated.

Panelboards and feeder pull boxes: Provide a grounding conductor of capacity as required by the N.E.C. between each ground lug on the panel or transformer and the supply source. The ground bus of the normal and emergency panels shall be bonded together with a copper conductor size in accordance with Article 250 of the N.E.C.

- B. Motors: Ground by means of a grounding conductor in the same raceway with the motor feeder connected to a grounding bushing at the motor terminal box, and the ground bus in the motor control center or to panel.
- C. Wherever flexible conduit is used for part of a conduit run, provide a grounding conductor in the conduit and connected to a grounding bushing or bus at each end of the run.
- D. Power receptacles: Ground by means of an insulated green grounding conductor terminated at the ground bus in the Branch Panelboard and to a ground terminal.
- E. The ground source shall consist of building steel, a ground field as indicated on drawings, and a connection to the cold water line in the interior of the building. All ground sources shall be connected with a copper conductor, sized according to N.E.C. Table 250 94.
- F. Maximum resistance to ground shall be 5 ohms.
- G. Luminaires: Luminaires supplied through flexible conduit or cord shall be grounded to the box through which they receive power. This ground shall be by means of a green conductor the same size as the power conductors connected to the box and to the Luminaire by connections approved for grounding by U.L. This grounding conductor shall be installed inside the flexible conduit or be manufactured into the flexible cord.
- H. Flexible Conduit: Ground continuity shall be maintained across sections of flexible conduit by means of a conductor having green colored insulation sized in accordance with Table 250 95 of the N.E.C. This conductor shall be terminated at each end and by means of approved grounding conductors attached to fixed portions of the raceway system or equipment (attachment to box or equipment cover mounting screws is unacceptable).

- I. All panels provided with an equipment ground bus shall have a ground conductor returned with the feeder conductors to the main switchboard ground bus. The ground conductors shall be sized in accordance with Table 250.95 in NFPA Publication No. 70 unless noted otherwise.

2.7 FUSES

- A. Fuses: Current limiting, non-renewable type, rated 200,000 AIC, with rejection feature; Class RK-5 for motors and transformers for ratings 600 amp and below and Class L for feeders rated 601 amp and above.
- B. Acceptable Manufacturers: Bussmann, Brush, Littelfuse or equal.

2.8 TERMINAL JUNCTION BOXES (TJB)

Provide hinged cover terminal junction boxes of the required type and size where indicated. Utilize enclosures as required in 16000-2.1. Provide terminal blocks with a separate connection point for each conductor entering or leaving the box. Provide metal back plate for mounted terminal blocks. Provide 20 percent spare terminal points. Paint interior surfaces with white enamel or lacquer.

2.9 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES

- A. For nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, provide heavy duty, oiltight type pushbuttons, indicating lights, selector switches, and stations for these devices. Utilize General Electric Type CR104P, or equivalent by Square D, Eaton, or equal.
- B. For nonhazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy duty corrosion resistant, watertight type pushbuttons, indicating lights, or selector switches mounted in NEMA 4X stainless steel (316) enclosures. Provide special gasketing required to make complete station watertight. Utilize Square D Type SK, General Electric, Eaton, or equal.
- C. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra large nameplates indicating their specific function. Provide pushbutton stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600.
- D. Utilize selector switches having standard operating levers. Make all indicating lights push to test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.10 TERMINAL BLOCKS 0 TO 600 VOLTS

- A. Provide 600 volt terminal blocks for termination of all control circuits entering or leaving equipment, panels, or boxes. Provide screw clamp compression, dead front barrier type terminal blocks with current bar providing direct contact with wire between the compression screw and yoke. Provide yoke, current bar, and clamping screws constructed of high strength and high conductivity metal. Utilize yoke that guides all strands of wire into the terminal. Utilize current bar providing dependable vibration proof connection. Supply terminals constructed to allow connection of wire without any special preparation other than stripping. Rail mount individual terminals to create a complete assembly and provide terminals constructed such that jumpers can be installed with no loss of space on terminal or rail.
- B. Size all terminal block components to allow insertion of all necessary wire sizes and types. Supply terminal blocks with marking system allowing the use of preprinted or field marked tags. Supply CSA certified and UL approved terminal blocks manufactured by Weidmuller, Ideal, Electrovert, or equal.

2.11 CONTROL RELAYS

- A. Provide magnetic control relays, NEMA Class A600 (600 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control type with field convertible contacts, and meeting the requirements of NEMA ICS Provide General Electric Type CR120B, Eaton Type M 600, or equal.
- B. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a timer attachment adjustable from 0.2 to 60 seconds (minimum) and field convertible from ON delay to OFF delay and vice versa.
- C. Where latching (mechanically held) relays or motor thermal detector relays are specified, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts. Utilize an attachment allowing 01 easy manual latching and unlatching.

2.12 ELAPSED TIME METERS

Provide synchronous motor driven, elapsed time meters, to 99,999.9 hours range, nonreset type, suitable for semiflush, panel mounting. Provide General Electric Type 240, 2 ½ inch Big Look unit, Eagle Signal Bulletin 705 unit, or equal.

2.13 CIRCUIT BREAKERS, INDIVIDUAL, 0 TO 600 VOLTS:

Mount individual circuit breakers complying with requirements for circuit breakers in this section in enclosure required for the location, unless otherwise indicated. Provide circuit breakers with handles that can be locked in the OFF

position. Interlock enclosure and circuit breaker to prevent opening the cover with the circuit breaker in the ON position.

2.14 CIRCUIT BREAKERS, 0 TO 600 VOLTS

- A. General: Provide circuit breakers of the indicating type showing ON/OFF and TRIPPED positions of the operating handle. Do not use single pole circuit breakers with handle ties where multipole circuit breakers are indicated. Utilize multipole circuit breakers designed so that an overload on one pole automatically causes all poles to open. Provide circuit breakers meeting the requirements of NEMA AB 1. Circuit breakers shall have a minimum interrupting rating equal to the maximum fault current available at the point of application or they shall be part of an assembly with an integrated equipment short circuit rating at least as great as the fault current available at the point of application. Where circuit breakers are used as service entrance equipment, provide units UL labeled for that use. Provide circuit breakers suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.
- B. Inverse Time Type:
 - 1. Provide thermal magnetic circuit breaker, unless otherwise shown, for one and two pole breakers, breakers operating at 240V or less, and three pole branch circuit breakers operating at 480V.
 - 2. Provide solid state trip circuit breakers with an adjustable short time function, unless another type breaker is required for coordination, or otherwise indicated on the Drawings, for three pole, 480V feeder circuit breakers with not more than one downstream, 480V, overcurrent protective device, excluding protective devices provided as part of a process equipment package. Such breakers shall be Eaton (formerly Westinghouse Seltronic Circuit Breakers), Square D, Type ME or PE Circuit Breakers, or equal.
 - 3. Provide solid state trip circuit breakers with at least the following adjustment: long time pickup, long time delay, short time pickup, short time delay, I^2t , for circuit breakers not covered by either of the above cases. Such breakers shall be General Electrical Circuit Breakers with Microversatrip; Eaton (formerly Westinghouse Circuit Breakers with Digitrip); or equal.
- C. Instantaneous Only Type: Instantaneous only circuit breakers shall have only an instantaneous trip element. The breakers shall be used only as part of a listed combination motor starter. Instantaneous only breakers shall be sized with a continuous rating of at least 115 percent of the full load current of the motor served. The trip setting shall be continuously adjustable from a lowest setting of not more than 700 percent to a highest setting of not less than 1,300 percent of the motor full load current.

Instantaneous only breakers shall be General Electric Mag Break; Eaton (formerly Westinghouse MCP); Square D Mag Guard; or equal.

PART 3 - EXECUTION

3.1 GROUNDING METHODS:

The ground for the facility electrical system, equipment ground and building ground shall be obtained by connecting the ground bus of the panelboard to the steel in the building foundation.

3.2 GENERAL WIRING METHODS:

- A. Wiring of all systems: Install wiring in a conduit, wireway, or under floor raceway systems as herein specified or as shown, unless specifically noted otherwise.
- B. Wiring: Provide wiring complete from point of service connection to all receptacles, Luminaires, clocks, power outlets, outlets for future extensions, and other devices as shown. Slack wire shall be provided for all future connections. Unless otherwise specified, branch circuit conductors shall be No. 12 AWG or larger. In outlet boxes for future installations, ends of wires shall be taped and blank covers installed.
- C. Cables shall not be bent either permanently or temporarily during installation to radii less than 10 times the outer dimensions.
- D. Conductors not larger than No. 10 located in switchboards, motor control centers and pull boxes shall be cabled in individual circuits. Bundling and cabling shall be done with nylon straps made of self extinguishing nylon having a temperature range of 65 degrees Fahrenheit. Each strap shall be constructed with a locking hub or head on one end and a taper on the other. Straps shall be Thomas & Betts "TY RAP" or equal.
- E. Luminaire connection: From an accessible approved raceway, outlet or junction box located above a suspended ceiling to recessed or surface Luminaires, provide minimum 3/8 inch flexible metallic conduit at least 4 feet and not more than 6 feet in length where indicated on drawings. The outlet or junction box shall be located a minimum of one foot and not more than 4 feet from the Luminaire. Additional raceways, outlet or junction boxes including conduit or electric metallic tubing extensions to those shown on the drawings, shall be provided where required to comply with the above length requirements. Minimum size No. 12 AWG phase and neutral conductors shall be installed as specified in flexible metallic conduit connections to Luminaire wireways shall be considered branch circuit conductors for the purpose of this specification.

END OF SECTION

SECTION 16110

RACEWAYS, BOXES, AND SUPPORTS

PART 1 - GENERAL

1.1 SCOPE

This section covers the furnishing and installation of electrical conduits, wireways, pull boxes, manholes, handholes, fittings and supports. Raceways shall be provided for lighting, receptacles, power, control, instrumentation, signaling and grounding systems.

1.2 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and the listed documents, the requirements of this section shall prevail.

REFERENCE	Title
ANSI	Rigid Steel Conduit-Zinc Coated
ANSI	Electrical Metallic Tubing-Zinc Coated
ASTM	Smooth-Wall Polyvinylchloride Conduit And Fittings For Underground Installation
FEDSPEC	Conduit, Metal, Rigid And Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated
FEDSPEC	Conduit And Conduit Fittings, Plastic, Rigid
NEMA	Industrial Control And Systems Enclosures
NEMA	Electrical Plastic Tubing (EPT) And Conduit (EPC 40 And EPC 80)
NEMA	Pvc And Abs Plastic Utilities Duct For Underground Installation
NEMA	Cable Tray Systems
NEMA	Enclosures For Electrical Equipment (1000 Volts Maximum)

NFPA 70	National Electrical Code (Nec)
UL	Flexible Metal Electrical Conduit
UL	Rigid Metal Electrical Conduit
UL	Liquid Tight Flexible Electrical Conduit
UL	Rigid Nonmetal Electrical Conduit
UL	Electrical Metallic Tubing

1.3 SUBMITTALS

The following information shall be provided in accordance with the General Conditions:

- A. Manufacturer's descriptive literature for all materials.
- B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (☐) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2 - PRODUCTS

2.1 BOXES AND FITTINGS

A. PULL BOXES AND WIRING GUTTERS:

Indoor boxes larger than FD boxes shall be constructed of sheet steel and galvanized after fabrication. Similar enclosures in wet or outdoor areas shall be NEMA 4X. Equipment shall be suitable for the environment in which it is installed. Box and gutter sizes, metal thickness, and grounding

shall comply with the National Electrical Code. Bolt on junction box covers 3 feet square or larger, or heavier than 25 pounds, shall have a rigid handle. Covers larger than 3 by 4 feet shall be split.

B. TERMINAL CABINETS:

Terminal cabinets located indoors shall be NEMA 12. Cabinets located outdoors and in corrosive areas shall be NEMA 4X. Cabinets shall be provided with hinged doors. Adjustable terminal strip mounting accessories shall be provided. Cabinets shall be provided with channel mounted terminal blocks.

C. MANHOLES:

Unless otherwise specified, manholes shall be precast concrete, 3000 psi strength at 28 days, with reinforcing and cover designed for H-20 bridge loading. Manhole dimensions shall be as indicated on the drawings. Necking and shaft shall have 36-inch minimum clear opening.

Manhole cover and frame shall be Class 30B grey cast iron per ASTM A48 with machine finished flat bearing surfaces. Manholes shall be watertight. Exterior walls of manholes shall be provided with 6 mils of waterproof membrane, Sonneborn HLM 5000 Series, or equal.

Duct entrees shall be no less than 14 inches above floor and below ceiling. Cables supports, clamps or racks shall be provided to support the cable at minimum 2-foot intervals. Concrete inserts shall be embedded in walls and ceiling. Floor shall slope 2 percent in all directions to a sump. Sump shall be a minimum of 18 by 18 by 12 inches deep.

Manhole walls shall be provided with boxouts with waterstops on all sides of each boxout. Waterstops shall be as specified in the Cast-in-Place Concrete section. Boxouts shall be sized to accommodate the penetrating underground duct banks.

D. HANDHOLES:

Handholes shall be precast concrete with checker plate, galvanized, traffic covers designed for H-20 loading. Dimensions shall be as specified on the drawings. Handholes shall be provided with precast solid concrete slab bottoms with sumps. Handholes shall be constructed of 3000 psi reinforced concrete. Handhole cover shall be engraved "ELECTRICAL" or "SIGNAL" as applicable.

Handhole walls shall be provided with boxouts, as specified for manholes.

2.2 RACEWAY SUPPORTS

A. CONDUIT SUPPORTS:

Hot-dip galvanized framing channel with end caps shall be provided to support groups of conduit. Individual conduit supports shall be one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required. Conduit supports for PVC coated rigid steel and PVC conduit systems shall be one-hole PVC coated rigid steel or clamps conduit wall hangers.

B. CEILING HANGERS:

Ceiling hangers shall be adjustable galvanized carbon steel rod hangers as specified. Straps or hangers of plumber's perforated tape are not acceptable. Unless otherwise specified, hanger rods shall be 1/2 inch all-thread rod and shall meet ASTM A193. Hanger rods in corrosive areas and those exposed to weather or moisture shall be stainless steel.

C. SUSPENDED RACEWAY SUPPORTS (RACKS):

Suspended raceway supports shall consist of concrete inserts, galvanized carbon steel rod hangers, and jamb nuts supporting hot dip galvanized framing channel or lay-in pipe hangers as required. Hanger rods shall be 1/2 inch all-thread rod and shall meet ASTM A193, unless otherwise specified. All suspended raceway supports shall be braced at 30-foot intervals (alternating from one side to the other) to meet specified seismic requirements.

2.3 CONCRETE ENCASED DUCT BANKS

Concrete used for duct banks shall be Class E with red oxide added as specified in the Cast-in-Place Concrete section.

2.4 UNDERGROUND MARKING TAPE

Underground marking tape shall be for early warning protection of digging around reinforced concrete duct banks. Tape shall be low density polyethylene plastic, nominally 6 inches wide and 4 mil thickness. The plastic color shall be red. A warning shall be imprinted continuously along the length, with message reading similar to "CAUTION - STOP DIGGING - BURIED ELECTRIC LINE BELOW." Tape shall be Brady "Identoline"; Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line"; or equal.

Underground marking tape for directly buried cables and conduits shall be 6-inch wide metallic lined tape with red polyethylene film on top and clear polyethylene film on the bottom. The message shall be clearly printed with black over red tape and shall read "CAUTION ELECTRIC LINE BURIED BELOW".

2.5 NAMEPLATES

Nameplates shall be provided for all boxes in accordance with the requirements of Section 16195. Nameplate wording shall be as indicated on the drawings. Where no wording is specified, the Contractor shall provide the functional description of the device on the nameplate.

2.6 FIRESTOPS

Firestops and seals shall be Flamemastic 77, Vimasco No. 1-A, or equal, and shall be applied in accordance with manufacturer's recommendations. Products which are affected by water are not acceptable.

2.7 RACEWAY IDENTIFICATION

Raceway number tags shall conform to the requirements of raceway markers, Section 16000.

PART 3 - EXECUTION

3.1 MANHOLES AND HANDHOLES

Unless otherwise specified, manhole and handhole installation shall be as follows:

- A. Manholes and handholes shall be set on a minimum of 6 inches of crushed rock on top of undisturbed or compacted earth.
- B. Manholes and handholes shall be set plumb, so that water shall drain properly to the sump.
- C. Manhole covers, unless otherwise specified, shall be set at 1 to 2 inches above finish grade with surrounding pavement sloping away from the manhole cover.
- D. All metallic hardware inside manholes and handholes shall be grounded by connection to the ground plate. Connections shall be made using bolted connections, bonding jumpers and grounding bushings.

3.2 RACEWAY NUMBERING

Each conduit shall be provided with a number tag at each end and in each manhole and/or pull box. Trays shall be identified by stencils at intervals not exceeding 50 feet, at intersections, and at each end.

3.3 RACEWAY SCHEDULE

A. GENERAL:

The Raceway Schedule is on the drawings.

B. UNSCHEDULED RACEWAY:

With the exception of lighting, communication, paging, fire alarm, security and receptacle circuits, the type and size of raceway shall be as specified on the drawings or schedules. Lighting and receptacle raceway are unscheduled and shall be sized by the Contractor in accordance with the NEC. Minimum size shall be 3/4 inch for exposed and 1 inch for embedded raceway.

The number and size of communication, paging, fire alarm, and security raceways shall be as required for the particular equipment provided subject to the minimum sizes specified above.

+++ END OF SECTION +++

SECTION 16111

CONDUIT

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of conduit, including rigid metal conduit and fittings, flexible metal conduit and fittings, liquid tight flexible metal conduit and fittings, non-metallic conduit and fittings, explosion proof flexible steel conduit, manholes, handholes and ductbanks. All conduit shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Equipment data specified in this Section.
- B. Catalog cuts.

1.3 QUALITY ASSURANCE

Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. ANSI C80.1
- B. ASTM F 512
- C. Fed Spec WW-C-581E
- D. Fed Spec WW-C-1094A
- E. NEMA TC2
- F. NEMA TC6

- G. NFPA 70
- H. UL 1
- I. UL 6
- J. UL 360
- K. UL 651

1.4 QUALITY STANDARDS

- A. All products covered by these specifications shall be in conformance with NEMA standards, and shall be UL approved.
- B. Manufacturers offering products that comply with these specifications include:
 - 1. Conduit: Allied, Republic, Triangle, Wheatland or equal.
 - 2. PVC Coated Conduit: Permacote, Robroy or equal.
 - 3. PVC Conduit: Amoco, Carlon, Certainteed or equal.
 - 4. Flexible Conduit: Anamet, Columbia, Electrilex or equal.
 - 5. Fittings: Appleton, Crouse-Hinds, Thomas & Betts or equal.

PART 2 - PRODUCTS

2.1 GENERAL

The size of raceway shall be as specified on the Drawings or schedules and the type of raceway will be in accordance with these Specifications. Lighting and receptacle raceways are not scheduled and shall be sized by the Contractor in accordance with the NEC. Minimum size shall be ¾-inch for exposed and 1-inch for embedded raceway. The number and size of communication and security raceways shall be as required for the particular equipment provided, subject to the minimum sizes specified above.

2.2 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: UL 6; ANSI C80.1; hot dip galvanized. Minimum size ¾-inch, exposed, 1-inch embedded or inaccessible.
- B. PVC Coated Conduit: NEMA RN-1; galvanized rigid steel conduit with factory applied external 40 mil PVC coating and 2 mil urethane interior coating. Prior to coating, treat conduit with a heat polymerizing adhesive so the bond between metal and coating is greater than the tensile strength of the coating. Minimum size ¾-inch.
- C. Fittings and Conduit Bodies: NEMA FBI; zinc coated; taper-threaded type, material to match conduit. Where PVC coated conduits are indicated all couplings, fittings, conduit bodies, pipe straps, U bolts, beam clamps, and other accessories are to be PVC coated.

2.3 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: UL 1; FS WW-C-566; single steel continuous strip with galvanized coating. Minimum size ½-inch.
- B. Fittings and Conduit Bodies: NEMA FB-1; malleable iron squeeze type.

2.4 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Conduit: UL listed liquidtight consisting of an extruded thermoplastic cover over a galvanized steel core. Minimum size ¾-inch.
- B. Fittings and Conduit Bodies: NEMA FB-1; galvanized steel compression type with O-ring.

2.5 RIGID NONMETALLIC CONDUIT AND FITTINGS

- A. Use rigid PVC Schedule 40 conduit, UL listed for concrete encased, underground direct burial, concealed and direct sunlight exposed use, and UL listed and marked for use with conductors having 90 degrees C insulation. Use conduits, couplings, bushings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W C 1094, UL, NEC, and ASTM specified tests for the intended use. Use only conduit with a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable. Minimum size ¾-inch exposed, 1-inch embedded or encased.
- B. Fittings for PVC conduit shall comply with Standard for PVC Fittings for use with Rigid Conduit and Tubing, NEMA TC3, and shall be NEMA Type IV.

2.6 EXPLOSION PROOF FLEXIBLE STEEL CONDUIT

Conduit shall be suitable for use in Class 1, Division 1, Groups C and D hazardous areas as specified in NEC and shall be watertight. Flexible conduit shall be used for final connections to motors and other equipment subject to vibration or adjustment in Class 1, Division 1 hazardous areas. Minimum size ½-inch.

2.7 RACEWAY IDENTIFICATION

Raceways number tags shall be brass with stainless steel attachment wire. Raceway number shall be embossed on to the tag with ¼-inch letters.

PART 3 - EXECUTION

3.1 CONDUIT APPLICATION

- A. Install the following conduit types, unless otherwise shown on the drawings.
 - 1. Outdoors, Exposed (Not Buried): PVC-coated galvanized rigid steel
 - 2. Indoors
 - a. Dry Areas - Galvanized Rigid Steel
 - b. Wet Areas - PVC-Coated Galvanized Rigid Steel
 - 3. Underground (Under Slabs-on-Grade, Encased or Embedded in Concrete)
 - a. PVC Schedule 40
 - 4. Hazardous Gas Areas
 - a. Galvanized Rigid Steel
 - 5. Corrosive and Chemical Areas
 - a. PVC-Coated Galvanized Rigid Steel
 - 6. Transition Areas and Final Connections to Equipment
 - a. Motor Connections – Flexible metal, liquid-tight conduit.
 - 1) Use explosion proof flexible conduit, described in section 16111 section 2.6, for motors located in Class 1, Division 1, groups C and D hazardous areas.
 - b. Lighting Luminaire Connections – Flexible metal non liquid-tight conduit in dry areas and liquid-tight in wet areas.
- B. Refer to Contract Drawings for conduit schedules.
- C. Where PVC conduit is indicated, make a transition to PVC coated rigid steel below grade or slab and continue above with PVC coated rigid steel conduit.

3.2 CONDUIT ARRANGEMENT AND SUPPORT

- A. Arrange conduit to maintain headroom and present a neat appearance. Run exposed conduits parallel or perpendicular to building surfaces and adjacent piping. Group conduit in parallel runs where practical and provide rack space for 25 percent additional conduits.
- B. Avoid sources of heat when possible. Where unavoidable, maintain 6-inch clearance when crossing hot pipes and 12-inch clearance between parallel hot pipes, flues, heating appliances, and other heat sources.
- C. Support conduits to prevent distortion of alignment by wire pulling operations. Fasten single conduits with one-hole malleable iron straps. For multiple runs use galvanized steel channel and clamps. Wire, perforated pipe straps and the like are not acceptable support means.
- D. Support conduit at a maximum of 7 feet on center and within 3 feet of each box, cabinet, or fitting. Hang trapeze assemblies with threaded rods not less

than 3/8-inch diameter. Remove all temporary supports prior to pulling conductors.

3.3 CONDUIT INSTALLATION

- A. In the event of any conflict between this section and Section 16114, this section shall govern.
- B. Cut conduit square using a saw or pipe cutter and de-burr and ream cut ends. Paint threads with zinc compound. Bring conduit to the shoulder of fittings and couplings and fasten securely. All connections are to be wrench tightened and electrically continuous. No running threads are permitted.
- C. Use conduit hubs for fastening conduit to boxes. Use conduit bodies to make sharp changes in direction. For sizes 2-inches and larger, use "LD" or similar fittings to permit a straight pull from either direction.
- D. The maximum length between pull points is 400 feet. This length shall be reduced by 100 foot for each 90 degree of bend.
- E. Use hydraulic one-shot shoe bender or factory elbows for bends in conduit larger than 2-inch size. Crushed or deformed conduits may not be installed.
- F. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- G. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture. Install threaded PVC end caps on conduits stubbed up for future use.
- H. Unless otherwise specified, conduit entering field equipment enclosures shall enter the bottom or side of the box.
- I. Provide a 200 pound tensile strength polyolefin line pulled through and tied off at each end of all empty conduits.
- J. Install expansion joints where conduit crosses building expansions joints and for straight runs in excess of 100 feet. See additional information in Section 16114.
- K. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating.
- L. Provide watertight seals, equal to OZ type WSK or FSK, where conduit penetrates exterior walls and where conduit passes between spaces normally at different temperatures.

- M. Provide clamp backs for conduits on exterior or damp surfaces to prevent the raceway from bearing directly on the damp surface.
- N. Route conduits in slabs above the bottom reinforcing and below the top reinforcing. Maximum size for conduits in slabs above grade is 1-inch. Route so conduits in slabs above grade do not cross.
- O. PVC conduit bends: Use PVC-coated rigid steel factory elbows.
- P. PVC coated conduit: Exercise care not to damage the coating during cutting, threading, bending, and assembly. Follow the manufacturer's installation instructions. Use vise jaws, bending equipment, strap wrenches, and other tools which are specifically designed for coated conduits. Do not use chain vise, pipe wrench, channel locks or the like.
- Q. Provide sealing compound equal to Chico A or Chico B where conduit passes from hazardous or corrosive area in to a non-classified area.
- R. Each conduit shall be provided with a number tag at each end.

3.4 UNDERGROUND DUCT BANK INSTALLATION

- A. Install top of duct bank minimum 24-inches below finished grade with plastic warning tape 12-inches below finished grade.
- B. Install conduit with minimum grade of 4-inches per 100 feet.
- C. Terminate conduit in end bell at manhole entries.
- D. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Use suitable separators and chairs installed not greater than 4 feet on centers to provide conduit spacing as indicated. Securely anchor conduit to prevent movement during concrete placement. Stagger conduit joints in concrete encasement 6-inches minimum.
- E. Construct duct banks with 3,000 psi concrete. Provide reinforcing bars as indicated. Each 50 lb. bag of concrete shall include 3 lbs of red oxide.
- F. Where duct bank passes beneath footings or slabs resting on grade excavate to provide a minimum of 6-inch clearance between the ductbank and the structure.
- G. Thoroughly swab inside of conduits upon completion of pouring concrete. Before backfilling, a mandrel, ½-inch smaller than the conduit diameter, shall be pulled through each conduit.

+++ END OF SECTION +++

SECTION 16114
EXPANSION DEFLECTION FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

See General Conditions for submittal requirements. Drawings and general provisions of Contract, including General Conditions and Division-1 specification sections apply to work in this section.

1.2 QUALITY CRITERIA:

INSTALLER shall be qualified to perform required task.

1.3 COMPLETENESS OF WORK:

Provide all boxes, offsets, bends, raceways, raceway supports, and fittings for the complete installation. Provide all components to complete the systems specified. Each unit of equipment shall be completely assembled and installed, and all surfaces shall be clean and free from dents, scratches, abrasions or marred areas. Any application of material or equipment from this section shall maintain fire rating and classified location ratings of existing walls, slabs, ceilings and building areas.

1.4 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install conduit expansion and deflection fittings where necessary for conduit thermal expansion or where crossing structural expansion joints. Coordinate location with ENGINEER.
2. Alternatively, contractor may install bends in the piping runs to accommodate expansion and contraction. Coordinate locations with ENGINEER.

1.5 REFERENCES

A. Standards referenced in this Section are:

1. UL 514B, Conduit, Tubing, and Cable Fittings.
2. UL 467, Grounding and Bonding Equipment.

1.6 QUALITY ASSURANCE

Regulatory Requirements: Comply with the following:
NEC Article 300, Wiring Methods.

1.7 SUBMITTALS

Action Submittals: Submit the following:

- A. Shop Drawings:
Listing of locations where fittings are required.
- B. Product Data:
Manufacturer's literature and technical information for expansion and deflection fittings proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Products and Manufacturers: Provide one of the following:
 - 1. Type DX for expansion/deflection or AX for expansion only, by O Z Gedney Company.
 - 2. Type XD for expansion/deflection or XJ for expansion only, by Crouse Hinds Company.
 - 3. Type DF for expansion/deflection or XJ for expansion only, by Appleton Electric Company.
 - 4. Or equal.
- B. Cast gray iron alloy or bronze end couplings, malleable iron, or hot-dipped galvanized body, stainless steel clamps and tinned copper braid bonding jumper. Fitting shall be watertight, corrosion resistant, UL-listed, and compatible with the conduit system.
- C. Features:
 - 1. Expansion/Deflection Fittings:
 - a. Axial expansion or contraction up to 3/4-inch.
 - b. Angular misalignment up to 30 degrees.
 - c. Parallel misalignment up to 3/4-inch.
 - 2. Expansion Fittings:
Expansion/Contraction: Eight-inch total movement.
- D. Expansion/Deflection fittings shall comply with UL 514B and UL 467.

PART 3 - EXECUTION

3.1 INSPECTION

Examine conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install fittings in accordance with Laws and Regulations.
- B. Provide expansion fittings on exposed conduit runs crossing structural expansion joints and where necessary to compensate for thermal expansion and contraction. Provide expansion fittings on exposed conduit runs exceeding 200 feet.
- C. Provide expansion/deflection fittings on embedded conduit runs crossing structural expansion joints. Provide fittings above waterstops.
- D. Unless specifically shown or indicated otherwise, when crossing structural expansion joints larger than one inch, provide expansion fitting together with expansion/ deflection fitting. Install fittings on each conduit run in accordance with manufacturer's recommendations to accommodate additional movement necessary.
- E. Provide expansion/deflection fittings for underground conduit runs at penetrations of buildings, manholes, handholes, and outdoor concrete equipment pads.
- F. Where required in non-metallic conduit and duct systems, provide rigid metal conduit nipples and metal rigid-to-PVC adapters for connection to fittings. Ensure that joints exposed to water or other liquid are made watertight.

END OF SECTION

SECTION 16121

INSTRUMENTATION AND COMMUNICATION CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

Scope:

- A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install instrumentation and communication cables.
- B. Types of cables include the following:
 - 1. Shielded instrumentation cables.
 - 2. Data communication cables.

1.2 TERMINOLOGY

The following words or terms are not defined but, when used in this Section, have the following meaning:

- A. “CPE” means chlorinated polyethylene.
- B. “FEP” means fluorinated ethylene-propylene.
- C. “XLPE” means cross-linked polyethylene.

1.3 REFERENCES

Standards referenced in this Section are:

- A. ASTM A510, Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
- B. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- C. ANSI/TIA/EIA-568, Commercial Building Telecommunications Cabling (requirements and restrictions of Technical Service Bulletins (TSBs) apply.)
- D. TIA/EIA-485, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems (known as RS-485).
- E. UL 13, Power-Limited Circuit Cables.
- F. UL 1581, Electrical Wires, Cables and Flexible Cords.

- G. UL VW-1, Vertical Wire Flame Test.
- H. UL 910, Safety Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air

1.4 QUALITY ASSURANCE

Regulatory Requirements:

- A. NEC 725, Class 1, Class 2, and Class 3 Remote-Control, Signaling and Power-Limited Circuits.
- B. NEC 727, Instrumentation Tray Cable.
- C. NEC 800, Communications Circuits.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
Product Data: Manufacturer's technical information for instrumentation cables and communications cables proposed.
- B. Informational Submittals: Submit the following:
Field Quality Control Submittals: Written report of results of field quality control testing specified in this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
Cables shall bear the UL labeled.
- B. Single Shielded Pair Instrument Cables:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Belden Company.
 - b. Okonite Company.
 - c. Dekoron Wire and Cable Company.
 - d. Or equal.
 - 2. Tinned copper, XLPE-insulated, stranded conductors, not less than no. 16 AWG, twisted pair, with overall shield, stranded tinned no. 18 AWG copper drain wire and overall PVC or CPE jacket. Rated for not less than 600 volts and complying with UL 1581.
- C. Multi-Paired Shielded Instrument Cables:
 - 1. Manufacturers: Provide products of one of the following:

- a. Belden Company.
 - b. Okonite Company.
 - c. Dekoron Wire and Cable Company.
 - d. Or equal.
 2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, twisted pairs with shield over each pair, stranded tinned no. 18 AWG copper drain wire, and overall PVC or CPE outer jacket. Rated for not less than 600 volts and complying with either UL 1581 or UL 13.
- D. Multi-Conductor Shielded Instrument Cables:
 1. Manufacturers: Provide products of one of the following:
 - a. Belden Company.
 - b. Okonite Company.
 - c. Dekoron Wire and Cable Company.
 - d. Or equal.
 2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, stranded tinned no. 18 AWG copper drain wire, with overall 100 percent foil shield and overall PVC or CPE jacket. Rated for not less than 600 volts.
- E. Cable Terminals:
 1. Manufacturers: Provide products of one of the following:
 - a. T&B Sta-Kon.
 - b. Burndy Insulug.
 - c. Or equal.
 2. Fork type copper compression terminals with nylon insulation for termination of cable at terminal blocks.

PART 3 - EXECUTION

3.1 INSPECTION

Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

General:

- A. Install cables complete with proper terminations at both ends.
- B. Install in conduit separate from power cables, unless shown or indicated otherwise.

- C. Ground shield on shielded cables at one end only and as recommended by instrument manufacturer.
- D. Identify conductors in accordance with Section 16195, Identification for Electrical Systems.
- E. Install and terminate Supplier-furnished cable in accordance with equipment manufacturer requirements and cable manufacturer's recommendations.
- F. Install in accordance with Laws and Regulations, including NEC.

3.3 FIELD QUALITY CONTROL

Site Tests:

- A. Test shielded instrumentation cable shields with ohmmeter for continuity along full length of cables, and for shield continuity to ground.
- B. Connect shielded instrumentation cables to calibrated 4 to 20 mA dc signal transmitter and receiver. Test at 4 and 20 mA transmitter settings.
- C. Replace with new cables the full length of cables that fail test.
- D. Test equipment shall be provided by CONTRACTOR.
- E. For testing of communications cables, test equipment used shall comply with the following:
 - 1. Equipment shall consist of a "master" and a "remote" unit.
 - 2. Test of all aspects of cables shall be automatic and initiated with a single command. Test over entire frequency range. Test unit shall be capable of accepting cable identification tag for reporting. Test unit shall return "pass/fail" status for cables and, if "fail", shall indicate reason for failure.
 - 3. Test unit shall be capable of storing all test results internally and printing the results later.
 - 4. For unshielded twisted pair cables, test unit shall be specifically designed and manufactured to certify cabling relative to Category

END OF SECTION

SECTION 16123

BUILDING WIRE AND CABLE

PART 1 - GENERAL

1.1 SCOPE

The contractor shall install all building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections as specified herein and as shown on the electrical drawings.

1.2 SECTION INCLUDES

- A. Product Requirements: Provide products as follows:
 - 1. Stranded conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 16 AWG for control circuits.
 - 5. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
 - 6. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire THHN/THWN insulation in raceway.
 - 2. Exposed Dry Interior Locations: Use only building wire THHN/THWN insulation in raceway.
 - 3. Above Accessible Ceilings: Use only building wire THHN/THWN in raceway.
 - 4. Wet or Damp Interior Locations: Use only building wire THHN/THWN insulation in raceway.
 - 5. Exterior Locations: Use only building wire THHN/THWN insulation in raceway.
 - 6. Underground Locations: Use only building wire THHN/THWN insulation in raceway.
 - 7. Conductor sizes are based on copper.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors and configurations.

- B. Test Reports: Indicate procedures and values obtained.
- C. Manufacturer's Installation Instructions
- D. Product Data: Submit for building.
- E. Samples:
 - 1. Submit 1 each, 18 inch length of cable assembly from each reel.
 - 2. Select each length to include complete set of manufacturer markings.
 - 3. Attach tag indicating cable size and application information.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Provide products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.5 RELATED SECTIONS

- A. International Electrical Testing Association: NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association: NFPA 70 - National Electrical Code.

1.6 CLOSEOUT SUBMITTALS

Project Record Documents: Record actual locations of components and circuits.

1.7 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 FIELD MEASUREMENTS

Verify field measurements are as indicated on Drawings.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
 - 4. Okonite Co.
 - 5. Anixter
 - 6. Southwire
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation: Thermoplastic material rated 75 degrees C for interior distribution. Use 90 degree C rated materials for exterior, exposed conduit runs.

2.2 NONMETALLIC-SHEATHED CABLE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
 - 4. Okonite Co.
 - 5. Anixter
 - 6. Southwire
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.

2.3 DIRECT BURIAL CABLE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
 - 4. Okonite Co.
 - 5. Anixter
 - 6. Southwire
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.

2.4 ARMORED CABLE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.

2. Essex Group Inc.
3. General Cable Co.
4. Okonite Co.
5. Anixter
6. Southwire

- B. Conductor: Copper
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 75 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Conductor Assembly Covering: Lead.

2.5 METAL CLAD CABLE

- A. Manufacturers:
 1. Diamond Wire & Cable Co.
 2. Essex Group Inc.
 3. General Cable Co.
 4. Okonite Co.
 5. Anixter
 6. Southwire
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 75 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Aluminum.
- G. Armor Design: Corrugated tube.

2.6 VFD CABLE

- A. Manufacturers:
 1. Okonite Co.
 2. Anixter
 3. Southwire
 4. Or approved equal
- B. Conductor: Stranded tinned copper. Wire sizes should not be smaller than No. 12 AWG for power and NO. 14 AWG for 120-volt control circuits.

- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 75 degrees C or 90 degrees C
- E. Insulation Material: Thermoset
- F. Approval: Type TC-ER per UL 1277, UL Type MTW. NFPA 79 2018, Wet Rating 75 degrees Celsius rated, Oil Resistant 1. DP-1 90 degrees Celsius, UL-AWM. Sunlight resistant and direct buried rated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

- A. Remove exposed abandoned wire and cable including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, when specifically required by the drawings; otherwise rewire new as part of this scope. When directed to utilize existing wiring and conduit, test material per NETA MTS before placing in service. Provide test results for approval by the ENGINEER before placing installation back into service.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

- C. Identify and color code wire and cable. Identify each conductor with its circuit number or other designation indicated.
- D. Neutrals: Run separate neutral wire for each phase load. The neutral wire shall not be shared in 3 phase 4 wire systems.
- E. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- F. Special Techniques - Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- G. Special Techniques - Direct Burial Cable:
 - 1. Trench and backfill for direct burial cable installation. Install warning tape along entire length of direct burial cable, within 3 inches of grade.
 - 2. Use suitable direct burial cable fittings and connectors.
- H. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solder less pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 - 7. Install solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 8. Install stranded conductors for branch circuits 10 AWG and smaller. However, when stranded conductors are used in lieu of solid, and then install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

3.4 WIRE COLOR

A. General

1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 - d. Black, Red, Blue for circuits at 575 volts.
 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 - d. Black, Red, Blue for circuits at 575 volts.
- B. Neutral Conductors: White or Gray. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
1. For 6 AWG and smaller: Green.
 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

PART 4 - FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE

The contractor shall furnish and install all switches and receptacles for lighting and miscellaneous power applications on the type and at the locations as specified herein and as shown on the electrical drawings.

1.2 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Poke-through service fittings.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Manufacturer's Installation Instructions.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Provide products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.5 RELATED SECTIONS

- A. Section 16100 – Basic Materials and Methods
- B. Section 16123 – Building Wire and Cable
- C. Section 16510 – Interior Luminaires
- D. Section 16160 – Panelboards
- E. Section 16520 – Exterior Luminaires

1.6 REFERENCES

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- B. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 2002.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

1.7 SUPPLIES & SPARE PARTS

- A. The contactor shall furnish 10% (minimum of 1) spare each receptacle, switch and plug furnished and installed for this project.
- B. Spare parts lists, included with shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as “1 lot of packing material” are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate part inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same number

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cooper Wiring Devices; www.cooperwiringdevices.com.
- B. GE Industrial; www.geindustrial.com.
- C. Leviton Manufacturing, Inc; www.leviton.com.

2.2 WALL SWITCHES

- A. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.
 - 1. Body and Handle: Ivory plastic with toggle handle.
 - 2. Indicator Light: Lighted handle type switch; red handle.
 - 3. Locator Light: Lighted handle type switch; red color handle.
 - 4. Ratings:
 - a. Voltage: 120 volts, AC.
 - b. Current: 20 amperes.

- B. Switch Types: Single pole, double pole, and 3-way.

2.3 RECEPTACLES

- A. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.
 - 1. Device Body: Ivory plastic.
 - 2. Configuration: NEMA WD 6, type as specified and indicated.
- B. Convenience Receptacles: Type 5 – 20R NEMA, 20Amps.
- C. Single Convenience Receptacles.
- D. Duplex Convenience Receptacles.
- E. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.4 WALL PLATES

- A. Jumbo Cover Plates: Ivory, smooth plastic.
- B. Weatherproof Cover Plates: Gasketed cast metal with hinged.

2.5 POKE-THROUGH FITTINGS

- A. Manufacturers:
 - 1. Hubbell Wiring Devices - Kellems; www.hubbell-wiring.com
 - 2. Thomas & Betts Corporation; www.tnb.com
 - 3. The Wiremold Company; www.wiremold.com
- B. Poke-Through Fittings: Assembly comprising service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination.
 - 1. Fire Rating: 3 hours.
 - 2. Type: Pedestal.
 - 3. Housing: Satin aluminum.
 - 4. Device Plate: Stainless steel.
 - 5. Configuration: One, duplex.

2.6 PLUGS

The contractor shall furnish suitable plugs with equipment furnished under the respective contract. Plugs shall be black rubber or plastic. For waterproof receptacle, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided provided with clamping nuts and stuffing gland cable outlets.

2.7 PROCESS INSTRUMENTS

- A. Manufacturers:
 - 1. Crouse-Hinds
 - 2. Appleton
- B. The contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument) to disconnect the 120 VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch with MT overload protection. For Hazardous locations, the device shall be a front operated general use snap switch mounted in an EFS enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that floor boxes are adjusted properly.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- E. Verify that openings in access floor are in proper locations.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top.
- E. Connect wiring device grounding terminal to outlet box with bonding jumper.

- F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- G. Connect wiring devices by wrapping conductor around screw terminal.
- H. Use jumbo size plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- J. Install protective rings on active flush cover service fittings.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install wall switch 48 inches (1.2 m) above finished floor.
- B. Install convenience receptacle 18 inches (450 mm) above finished floor.
- C. Install convenience receptacle 6 inches (150 mm) above counter.
- D. Install dimmer 48 inches (1.2 m) above finished floor.
- E. Install telephone jack 18 inches (450 mm) above finished floor.
- F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches (1.4 m) above finished floor.
- G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches (1.2 m) above finished floor.

3.5 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01650.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify that each receptacle device is energized.
- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

Adjust devices and wall plates to be flush and level.

3.7 CLEANING

Clean exposed surfaces to remove splatters and restore finish.

3.8 CIRCUTING

Convenience receptacles shall be grouped on circuits separate from lighting circuits. A maximum of eight (8) convince outlets are permitted per 20A, 120V circuit

END OF SECTION

SECTION 16150
ELECTRIC MOTORS

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of all electric motors. All electric motors shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Expected and guaranteed minimum efficiency values and power factor for operation at 100, 75, 50, 25 and 0 percent load.
- B. Type of enclosure.
- C. Overall dimensions and proposed size and location at terminal junction boxes.
- D. Noise level guarantee.
- E. Bearing life certificate.
- F. Starting characteristics, including torque and lock rotor current.
- G. Motor nameplate data.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - A. NEMA MG 1.
 - B. UL 674.

- C. UL 1004.
- B. Efficiency: High efficiency; guaranteed minimum values determined in accordance with IEEE Standard 112, Test Method B including stray load loss as follows; or as specified in other Divisions:

	-----Synchronous RPM-----			
HP	3600	1800	1200	900 & less
15 - 49	90%	91%	90%	88%
50 - 99	92	93%	92%	90%
100 & Above	94%	95%	94%	92%

NOTE: PROVIDE THE MANUFACTURER'S HIGHEST AVAILABLE DESIGN FOR MOTORS LESS THAN 15 HORSEPOWER AND FOR MOTORS SPECIFIED WITH SPECIAL TORQUE (NEMA DESIGN C OR D) OR DUTY CYCLE (INTERMITTENT OPERATION).

1.4 QUALITY STANDARDS

- A. Motors shall be designed, manufactured and tested in accordance with the latest revisions of the following standards:
 - A. NEMA Standards.
 - B. IEEE Standards.
 - C. ANSI Standards.
 - D. UL Standards.
- B. Manufacturers offering products that comply with these specifications include:
 - A. General Electric.
 - B. Reliance.
 - C. U. S. Motors.
 - D. Or equal.

1.5 PERFORMANCE

Motors shall be adequate for long periods of inactivity and the effects of an atmosphere that is made corrosive by traces of chemicals normally present in a wastewater treatment plant, and environmental conditions existing at the plant site such as high humidity, insects, plant life, fungus, rodents, etc. When motors are to be inactive in excess of 30 days, the Contractor shall maintain the bearings and rotate the shaft twice a month for the duration of the inactive period. The insulation of all drip-proof and weather-protected motors shall be specially designed for use in atmospheres containing moisture and corrosive fumes, which are normally encountered in wastewater treatment plants.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these specifications, unless otherwise indicated:
- B. Unless otherwise specified, all AC motors shall be squirrel cage induction type, rated for continuous duty at service conditions specified herein.
- C. The connected load (maximum horsepower required) of each motor shall not exceed its nameplate horsepower rating (exclusive of service factor) under any anticipated operating condition. All motors, except on VFD controllers shall have a service factor of 1.15. VFD drive controlled motors shall meet NEMA MG-1, no exceptions.
- D. Motors with synchronous speeds of 1,800 rpm or higher shall have full load current not exceeding the values in NEC Table 430-150. Motors with synchronous speeds of 1,200 rpm shall have full load current not exceeding 110 percent of the above values.
- E. Motors shall be rated for a 40 degrees C ambient temperature unless specifically indicated otherwise.
- F. Motors shall have a grounding terminal in the motor terminal junction box. The bolt which attaches the grounding lug to motor terminal junction box shall not be used for any other purpose (such as mounting the box to the motor).
- G. Drip-proof and weather protected motors shall have 316 stainless steel screens over all openings.
- H. Motors specified as totally enclosed and rated 5 horsepower or less may be either fan ventilated or nonventilated. Motors specified as totally enclosed and rated over 5 horsepower shall be fan ventilated.

2.2 MOTOR CONDUIT BOXES

- A. Conduit boxes shall be NEMA 7 made of cast iron and shall be of adequate size to permit terminating leads. It shall be possible to rotate these boxes in steps of 90 degrees. Conduit box shall be of adequate size and shall have a sufficient number of correct size openings to accept, all required conduits.

- B. Torque Classification: Motors shall match the torque requirements of the driven equipment.

2.3 MOTOR EFFICIENCY AND POWER FACTOR

- A. Motors shall be NEMA Design B, of the energy efficient type unless otherwise noted. The motor guaranteed minimum efficiency at full load shall not be less than the values shown in Table 1, in Part 1.3 B.
- B. The guaranteed minimum efficiency shall be submitted with the shop drawings. Any motor not meeting the minimum efficiency shall be rejected. If the motor is found in the field to be of a lower efficiency than specified, it shall be replaced with a new motor meeting these specification and efficiency requirements.

2.4 MOTORS OPERATED FROM ADJUSTABLE SPEED DRIVE CONTROLLERS

Provide NEMA MG-1 compliant motors with sufficient nameplate rated capacity to drive the specified equipment and to provide the specified margin between system capacity and connected load after any motor derating required to allow for extra heating in the motor due to the harmonic content in the voltage supplied by the controller. The adjustable frequency drive system supplier shall be responsible for a properly sized and completely compatible drive system. For small PWM drives, motor insulation system shall be suitable for volts/per microsecond = 1200 maximum. For large current source drives, motors shall be compatible with the drive.

2.5 RATING

- A. Horsepower (HP): As noted. Where no value is noted, match the requirements of the driven equipment.
- B. Phase:
 - A. Less than ½ HP: Single Phase.
 - B. ½ HP and Larger: Three-Phase.
- C. Voltage:
 - A. Single Phase Motors: 115/230 volt, 1 phase, 60 Hz.
 - B. Three-Phase Motors: 460/230 volt, 3 phase, 60 Hz.
- D. Speed, Revolutions Per Minute (RPM): As noted. Where no value is noted, match the requirements of the driven equipment.
- E. Torque and Starting Current: Exceptions: Provide NEMA design C or D where required by the driven equipment. Unless specifically noted NEMA design A motors are not acceptable.

- F. Insulation and Temperature Rise: Except as noted, Class F insulation with temperature rise, measured by resistance, corresponding to the insulation class in accordance with NEMA standards for operation in a 40-degree C ambient. Exception: For motors used with variable frequency drives provide Class F insulation with temperature rise in accordance with Class B limits.

2.6 CONSTRUCTION

- A. Enclosure: Totally enclosed fan cooled (TEFC) cast iron frame with stainless steel drain/breather unless otherwise noted.
- B. Windings: Copper.
- C. Starting: As noted.
- D. Multispeed motors: Two winding type unless otherwise noted.

2.7 ACCESSORIES

- A. Provide lifting eyes for 182 and larger frame size.
- B. Provide normally closed thermostat for winding protection.
- C. Nameplate: Permanently affixed and stamped so as to permit recovery of the nameplate data in the event the nameplate is painted over.

2.8 SEVERE DUTY MOTORS

Motor types designated as severe duty shall have the following minimum features as defined by NEMA:

- A. Totally enclosed, mill and chemical duty.
- B. Cast iron frames and end shields.
- C. Stainless steel hardware, drains, breathers and nameplates.
- D. Capillary type drains/breathers.
- E. Nonsparking, corrosion-resistant fans.
- F. Gasketed conduit boxes.
- G. Nonhygroscopic epoxy varnish sealed windings.
- H. Extra dips and bakes of insulating varnish for moisture protection of windings.

2.9 SEVERE DUTY EXPLOSION PROOF MOTORS

Motor type designated as severe duty explosion proof motor shall have the following features:

- A. Corrosion resistant finish.
- B. UL listed for explosion-proof motors, in accordance with UL 674 for Class I, Group D hazardous atmosphere.

2.10 MOTOR TYPES

Motor types indicated in the detailed equipment specifications are defined as follows:

Type 1: Horizontal, variable speed, explosion proof motor for Class I, Group D Hazardous Atmosphere. The motor shall have the following modifications:

- A. Breather/drain device
- B. Frame temperature thermostat, normally closed contact

PART 3 - EXECUTION

3.1 GENERAL

- A. All motors shall be designed, manufactured, and tested in accordance with the latest edition of NEMA MG 1. All motors shall be able to start, accelerate, and drive the design load of the driven equipment without exceeding any of the specified design requirements.
- B. Finish shall be manufacturer's standard gray or ANSI 61 gray over a primer and rust inhibitor, unless detailed under motor types and in accordance with 09900 Section, Painting.

3.2 INSTALLATION

- A. Verify clearances and alignment prior to operation.
- B. Lubricate in accordance with the manufacturer's instructions.
- C. Check rotation and correct as necessary

END OF SECTION

SECTION 16155

LOW-VOLTAGE COMBINATION MAGNETIC MOTOR STARTERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install low-voltage combination magnetic motor starters.

B. Related Sections:

1. Section 16000, Electrical Power and Systems.
2. Section 16100, Basic Materials and Methods.
3. Section 16195, Identification for Electrical Systems.
4. Section 16960, Control Circuits and Pilot Devices

1.2 REFERENCES

Standards referenced in this Section are:

- A. NEMA ICS 2, Controllers, Contactors and Overload Relays Rated 600 Volts.
- B. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

Action Submittals: Submit the following:

A. Shop Drawings:

1. Listing of low-voltage combination magnetic motor starters to be furnished, listing for each the installation location, NEMA rating and enclosure size, and equipment to be controlled.
2. Customized wiring diagrams for low-voltage combination magnetic motor starters.

B. Product Data:

Manufacturer's technical information, specifications, and standardized wiring diagrams for low-voltage combination magnetic motor starters proposed.

PART 2 – PRODUCTS

2.1 EQUIPMENT

- A. Manufacturers: Provide products of one of the following:

Flint River Pump Station Upgrade

16155-1

1. Square D Company.
 2. Allen Bradley Company.
 3. General Electric Company.
 4. Eaton.
 5. Or equal.
- B. Design, fabricate, and test low-voltage combination magnetic motor starters in accordance with NEMA ICS 2 and NEMA 250.
- C. General:
1. Type: Combination type with magnetic-only motor circuit protector with interrupting rating of not less than 65,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Magnetic coil operated, NEMA horsepower rated, with thermal overload protection. Coil shall be rated 120 vac.
 2. Enclosures: Panel enclosures shall be as required for area classifications specified in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.
 3. Functional Type: Full-voltage, single speed, non-reversing, unless otherwise shown or indicated on the Drawings.
 4. Control power transformer fused and grounded on low-voltage (120 vac) side for each starter.
 5. Auxiliary contacts for motor space heaters, remote status signals, and interlocks as shown or indicated on the Drawings and as required.
 6. Overload Relays: Provide an overload relay for each motor starter. Overload relays shall be in accordance with:
 - a. Electronic Overload Relays: Relays shall be electronic type, multi-function, adjustable, current sensing type, that include overload, phase-unbalance, phase-loss, and equipment type ground fault in one package.
 - b. Each overload relay shall be manual-reset type and include provisions for resetting by an insulating button on front of starter unit door.
 - c. Overload relay shall include normally-open auxiliary contact for remote alarm purposes.
 - d. Size overload relay for full-load amperes and service factor of actual motors installed.
 7. Pushbuttons, selector switches, pilot lights, and other devices shall be as shown on the Drawings and in accordance with Section 16960, Control Circuits and Pilot Devices.
 8. Provide nameplate identifying equipment controlled in accordance with Section 16195, Identification for Electrical Systems.

PART 3 – EXECUTION

3.1 INSPECTION

Examine conditions under which Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

General:

- A. Install equipment in accordance with the Contract Documents, Laws and Regulations, and manufacturer's installation instructions.
- B. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- C. Securely fasten equipment to walls or other surfaces on which equipment is mounted. Provide suitable 1/4-inch spacers so that enclosure is not installed directly against walls. Provide supports to rigidly support equipment reasonably close to motor where no wall or surface capable of supporting equipment exists.

++ END OF SECTION ++

SECTION 16160

PANELBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install panelboards.
- B. Related Sections:
 - 1. Section 16000, Electrical Power Systems.
 - 2. Section 16100, Basic Materials and Methods
 - 3. Section 16195, Identification for Electrical Systems.
 - 4. Section 16451, Dry-Type Low-Voltage Distribution Transformers
 - 5. Section 16289, Surge Protective Devices.

1.2 REFERENCES

- A. NEMA PB 1, Panelboards.
- B. UL 67, Panelboards.

1.3 SUBMITTALS

- A. Shop Drawings:
Listing of panelboards to be furnished with identification of their proposed location, and all electrical characteristics, including number and rating of branch circuit breakers and enclosure type.
- B. Product Data:
Manufacturer's technical information for panelboards proposed for use, including product literature and specifications. Indicate options and features to be provided.

1.4 QUALITY ASSURANCE

Regulatory Requirements; Comply with the following:
NEC Article 408, Switchboards and Panelboards.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Packing:
 - a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.

- b. Protect mating connections.
 - c. Cover all openings into enclosures with-vapor inhibiting, water-repellent material.
 - 2. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work. Upon deliver, check materials and equipment for evidence of water that may have entered equipment during transit.
- B. Storage and Protection:
Store panelboards in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Panelboards:
- 1. Manufacturers: Provide products of one of the following:
 - a. General Electric Company.
 - b. Eaton/Cutler-Hammer.
 - c. Schneider Electric/Square D Company.
 - d. General Electric
 - e. Or equal.
 - 2. Rating: Voltage rating, current rating, number of phases, number of wires and number of poles as shown or indicated on the Drawings.
 - 3. Circuit Breakers: Molded case, bolt-in thermal magnetic type with number of poles and trip ratings as shown or indicated. Where indicated on the Drawings, circuit breakers shall be ground fault circuit interrupting type equipped with solid state sensing and five-milliamp sensitivity.
 - 4. Circuit breakers for 480-volt panelboards shall have minimum interrupting rating of 18,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Circuit breakers for other panelboards shall have minimum interrupting rating of 10,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings.
 - 5. Bus Bars: Bus bars shall be 98 percent conductivity copper. Four-wire panelboards shall have solid neutral bar. Each panel shall have ground bus bar.
 - 6. Main: Panelboards shall have main circuit breaker, unless the Drawings specifically indicate main lugs only.
 - 7. Connect branch circuit breakers for sequence phasing.
 - 8. Enclosures: Panel enclosures shall be as required for the area classifications indicated in Sections 16100, Basic Electrical Materials and Methods, unless otherwise indicated on the Drawings.
 - 9. Construction: Code-grade steel, ample gutter space, flush door, flush snap latch and lock. Panelboards shall comply with NEMA PB 1 and UL 67.
 - 10. Trim: Surface or flush as required.

11. Directory: Typed or computer-printed card, with transparent protective cover in frame on back of door giving circuit numbers and area or equipment served.
12. Identification: Identify panelboards in accordance with Section 16195, Identification for Electrical Systems. Identification shall indicate panel number and voltage.
13. Directory of Existing Panelboards: When adding or removing breakers or loads from existing panelboards, provide a new typed or computer-generated directory card, indicating the circuit numbers and equipment served.
14. Provide surge protective device in accordance with Section 16289, Surge Protective Devices, for each panelboard shown or indicated on the Drawings. Surge protective device shall be included and factory-mounted within panelboard by panelboard manufacturer. Surge protective device monitoring and display shall be visible from front of panelboard.

B. Integrated Panelboard and Transformer:

1. Products and Manufacturers: Provide products of one of the following:
 - a. Mini-Power Zone by Schneider Electric/Square D Company.
 - b. Mini-Power Center by Eaton/Cutler-Hammer.
 - c. Panel Tran by Acme Electric Corporation.
 - d. Or equal.
2. General: Unit shall consist of encapsulated dry-type transformer, primary and secondary main circuit breakers, and secondary panelboard all in one enclosure.
3. Transformer Rating: Transformer portion shall comply with Section 16451, Dry-type Low-Voltage Distribution Transformers. KVA, primary voltage, secondary voltage, frequency and number of phases shall be as shown or indicated on the Drawings.
4. Branch Circuits: Molded case circuit breakers, plug-in thermal magnetic type with number of poles and trip ratings as shown or indicated on the Drawings.
5. Enclosure: Enclosures shall be as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.

PART 3 – EXECUTION

3.1 INSPECTION

Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Mounting: Install panelboards at locations shown or indicated. Set cabinets so that top branch circuit breaker is not over six feet above the floor.
- B. Directory: Complete typewritten or computer-printed directory indicating items controlled by each circuit breaker and the size of feeder serving the panel.

- C. Arrange circuits to balance the loads on the panelboards.
- D. Identify panelboards in accordance with Section 16195, Identification for Electrical Systems.
- E. Install in accordance with Laws and Regulations, manufacturer's recommendations, and the Contract Documents. Verify proper installation prior to energizing panelboards.

END OF SECTION

SECTION 16161
SWITCHBOARDS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies indoor, front accessible, deadfront power distribution switchboards rated 600 volts, 3 phase, 60 Hertz.
- B. Provide CT's as shown on the electrical drawings.
- C. Switchboard shall be free standing and shall not exceed 66" in width.

1.02 QUALITY ASSURANCE

A. References:

- 1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- 2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI C57.13	Requirements for Instrument Transformers
IEEE	Institute of Electrical and Electronic Engineers
NEMA PB 2	National Electrical Manufacturer Association Deadfront Distribution Switchboards
UL 891	Underwriters Laboratory - Deadfront Switchboards

B. Factory Tests

- 1. Switchboards shall be tested for operation at the specified voltage and current ratings after assembly. The main circuits shall be given a dielectric test of 2,200

volts for 1 minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1,500 volts for 1 minute between live parts and ground.

2. Instrument transformers shall have ratio and phase angle tests made in conformance with ANSI C57.13.

1.03 SUBMITTALS

A. The following information shall be submitted in accordance with Section 01 33 00:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Supplier/Subcontractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.
2. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Supplier/Subcontractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*
3. A copy of the contract document single line diagrams, building plan, and elevation drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
4. Catalog data on all electrical devices and components mounted on or within the switchboard.
5. Manufacturer's data indicating interrupting, withstand, and continuous current ratings of all relevant equipment and components.
6. Arrangement and layout drawings of the switchboard enclosures indicating equipment and bus arrangement and dimensions including areas of permissible cable entries. A list of material and components shall accompany the layout drawings. Include weight and shipping split data.
7. Manufacturer's certification that equipment meets the seismic requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards shall be provided in accordance with UL 891, NEMA PB 2, and as specified. Provide Arc Flash mitigation products that are offered in the manufacturer's literature.
- B. The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers include:
 - 1. Eaton Cutler-Hammer
 - 2. ABB equal
 - 3. Siemens equal
 - 4. Schneider equal
 - 5. Tech 4 equal

2.02 CONSTRUCTION

- A. Arrangement:
 - 1. Switchboards shall be new, deadfront, indoor type, metal enclosed, self-supporting, and suitable for 600 volts, 3 phase, 3 or 4 wire service as shown. Suitable for mounting against a wall without rear access.
 - 2. Switchboards shall be provided with vertical sections bolted together to form rigid units with switching and protective devices of the number, rating, and type specified.
 - 3. Interconnections, instrumentation, and control wiring shall be completed in the factory so that site work is limited to bolting shipping sections and connecting cable assemblies.
- B. Structure: Structural members shall be universal frame die formed type, bolted and braced using self-tapping bolts. Cover plates shall be steel having formed edges. Front plates shall be sectionalized and removable. Lifting eyes shall be provided and switchboards shall be capable of being rolled or moved into position and bolted directly to the floor without the use of floor sills. Switchboard enclosures shall be as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.

2.03 COMPONENTS

- A. Bus Bars:
 - 1. Buses shall be tin-plated copper of sufficient size to limit the temperature rise to 65 degrees C, based on UL 891.

2. Unless otherwise specified, buses shall be braced to withstand short circuit stresses up to 65,000 RMS amperes. Main horizontal bus shall be mounted on glass polyester insulators and shall have the continuous capacity specified.
3. A ground bus having a momentary rating at least equal to the highest momentary rating of any circuit breaker in the assembly shall extend the full length of the switchboard. Ends of the ground bus shall be provided with clamp-type terminals for No. 4/0 AWG bare copper grounding conductors.

B. Circuit Breakers:

1. General: Circuit breakers shall be stored energy type mechanism to provide quick-make, quick-break, trip-free operation:
 - a. Breakers with 1,200-amp and larger frames shall be provided with trip units equipped with arc flash reduction maintenance system technology capability. The arc flash reduction maintenance system shall allow the operator to enable a maintenance mode which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode. Provide 30.5 mm switch and indicator mounted at the breaker/enclosure.
 - b. Breakers larger than 100 amps: Molded case UL listed 100 percent continuous current capacity.
 - c. Breakers 100 amps and smaller: Molded case UL listed 80 percent continuous current capacity.
 - d. Ground fault protection shall be provided as specified or indicated.
2. Circuit breakers shall provide manual switching operation by means of a low-torque handle or pushbutton on the front of the unit. Automatic operation during overload and short circuit conditions shall be provided by solid state or thermal magnetic tripping devices located in the circuit breaker frame as specified on the drawings.
3. Circuit breakers shall be front accessible, stationary, individually or group mounted, and shall have short circuit capabilities equal to or greater than the system in which they are installed.
4. Circuit breakers shall have a minimum interrupting current of 65,000 amperes symmetrical RMS at 480 Vac or as listed on the contract documents and as confirmed by the coordination study.
5. Static Tripping Devices: Solid state static tripping devices shall consist of current sensors, logic assembly, magnetic latch release, and required interconnecting wiring. Tripping devices shall be automatic and self-contained within the breaker frame and shall not require any external relaying or power supplies.
 - a. Tripping functions shall be field adjustable and contain the following tripping characteristics:
 - 1) Overload tripping:
 - a) Adjustable ampere setting
 - b) Adjustable long-time delay

- 2) Short circuit tripping:
 - a) Adjustable short-time pickup
 - b) Adjustable short-time delay
 - c) Adjustable instantaneous pickup
- 3) Ground fault tripping:
 - a) Adjustable ground fault pickup
 - b) Adjustable ground fault delay

C. Panel Instruments and Accessories:

- 1. Panel instruments and accessories shall be as specified on the drawings or schedules and provided in accordance with Section 16175 where the section is included in the Contract Documents or provide the manufacturer's standard metering with associated potential and current transformers with accessories.
- 2. A networked, digital power monitoring device shall be provided for each bus to display voltage, current, kW, kVA for each phase locally and displayed via the Plant SCADA system.

D. Nameplates:

- 1. In addition to the manufacturer's identification, switchboards shall be provided with phenolic nameplates indicating switchboard, main breaker, and feeder breaker designations as specified. Nameplates shall comply with Section 16195 and the NEC for uniquely labeling the power loads and using equipment Tag Numbers and Tag Descriptions where shown on the drawings or schedules.
- 2. All switchboards supplied by a feeder shall be marked to indicate where the power supply source is located as required by NEC 408.4(B).

E. Conductor Markers:

- 1. Conductor markers shall comply with Section 16195.

F. Wiring:

- 1. Internal switchboard wiring shall consist of single conductor SIS 90 degree C copper wire and UL listed for panel wiring. The wire shall be sized to suit load requirements. Minimum size shall be No. 14 AWG.

2.04 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01780:

- 1. Results of breaker setting tests as specified in paragraph 3.02.
- 2. Operation and maintenance information and final reviewed submittal.

PART 3 EXECUTION

3.01 PROTECTIVE DEVICE SETTINGS

- A. The protective relays and static tripping devices shall be adjusted to the settings specified in the protective device coordination study prior to energizing the switchboard.

3.02 FIELD TEST

- A. Each switchboard breaker shall be adjusted, set and tested.

END OF SECTION

SECTION 16165

DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install disconnect switches.

- A. All outdoor disconnect switches shall be NEMA 4X 316 Stainless Steel and have an auxiliary set of contacts for position monitoring.

1.2 REFERENCES

- A. UL 98, Enclosed and Dead-Front Switches.
- B. NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- C. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 QUALITY ASSURANCE

Regulatory Requirements:

- A. NEC Article 404, Switches.
- B. Disconnect switches shall bear the UL label.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
Listing of each switch to be furnished, including location, rating, and NEMA enclosure type for each.
 - 2. Product Data:
Manufacturer's technical information for disconnect switches proposed for use.
- B. Maintenance Material Submittals: Submit the following:
Extra Stock Materials:
Furnish one set of spare fuses for each fused disconnect switch to be installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Manufacturers: Provide products of one of the following:

- A. Square-D Company

- B. Eaton
- C. ABB/General Electric Company
- D. Siemens
- E. Or equal

2.2 MATERIALS

- A. Service Disconnect Switches:
 - 1. Type: Fused, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in "OFF" position and safety handle.
 - 2. Rating: Voltage, current and short circuit ratings and number of poles as shown or indicated on the Drawings. Switch shall bear UL label indicating suitability for use as service equipment and shall comply with UL 98, NEMA KS 1, and NEMA 250.
 - 3. For switches connected to VFD's, provide auxiliary dry contacts to indicate switch position.
- B. Single Throw, Circuit Disconnect Switches:
 - 1. Type: Fused or unfused, horsepower rated, heavy-duty, single throw, quick- make, quick-break mechanism, visible blades in the "OFF" position and safety handle.
 - 2. Rating: Voltage and current ratings and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label and shall comply with the requirements of UL 98, NEMA KS 1 and NEMA 250.
 - 3. Provide auxiliary dry contacts to indicate switch position. Provide padlock, lockout capability for safety switches intended to serve as safety disconnects for motor and pump station equipment loads.
- C. Disconnect Switches for 120-volt, Single-phase Circuits:
Refer to Section 16140, Wiring Devices.
- D. Enclosures: NEMA rating shall be as required for area classifications specified in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.
- E. Identification:
 - 1. Identify enclosures in accordance with Section 16195, Identification for Electrical Systems.
 - 2. Provide nameplate to identify the equipment served by disconnect switch and associated source of power.

PART 3 - EXECUTION

3.1 INSPECTION

Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Due to Classified are locations certain disconnect switches will not be required since the means of disconnect to meet NEC will be performed at the MCC via approved lockable and tag methods.
- B. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- C. Securely fasten equipment to walls or other structural supports on which they are mounted. Provide independent stainless steel supports where no wall or other structural surface exists. Mount disconnect enclosures at a height not exceeding six feet.
- D. Provide suitable 1/4-inch spacers to prevent mounting enclosure directly against walls.

++ END OF SECTION ++

SECTION 16175
INSTRUMENT TRANSFORMERS, METERS, SWITCHES AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of accessories for low voltage switchgear, medium voltage motor starters, low voltage motor control assemblies and switch boards. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Product data indicating the general features and dimensions of devices.
- B. Burden, accuracy class and ratio data for instrument transformers.
- C. Operation and maintenance manuals.

1.3 QUALITY ASSURANCE

Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. ANSI C37.20.
- B. ANSI C39.1.
- C. ANSI C57.13.

D. NEMA STD.11.

PART 2 - PRODUCTS

2.1 INSTRUMENT TRANSFORMERS

A. General:

Instrument transformers shall be molded dry-type in accordance with ANSI C57.13. Transformer volt-ampere rating shall be suitable for carrying the specified load without overheating or exceeding the permissible accuracy for the transformer.

B. Potential Transformers:

Potential transformers shall have an ANSI accuracy class of 0.3. They shall be equipped with current limiting fuses.

C. Current transformers:

Current transformers shall be furnished with the specified ratios. Transformers shall be 5 ampere secondary bar or window type with single secondary winding and secondary shorting device. The accuracies shall conform to ANSI C37.20.

2.2 PANEL METERS

All indicating meters shall be 4-½-inch square, semiflush mounted, dusttight switchboard type. Moving elements provided with zero adjustments and the movement shall be taut-band with an accuracy of plus or minus 1 percent of full scale. The case shall be black. The scale shall be white with black markings. The length of the scale shall be greater than 7 inches over a deflection angle of 250 degrees. The meters shall be manufactured in accordance with applicable requirements of ANSI C39.1

2.3 INSTRUMENT SWITCHES

A. Control and instrument switches shall be heavy duty oil tight units rated 20 amperes at 600 volts. Instrument switches shall be provided with contact blocks and positions specified. Switches shall be of the rotary-cam type and contacts shall have positive wiping action of silver-to-silver contact buttons, 5000,000 operation mechanical life. Switches shall be provided with escutcheon plates and pistol-grip handles. Switches shall be General Electric, SBM, Westinghouse, W-2; or equal.

B. Voltmeter and ammeter switches shall have four positions with the escutcheon legend as follows:

Voltmeter	OFF	1-2	2-3	3-1
Ammeter	OFF	Phase A	Phase B	Phase C

2.4 KEY INTERLOCK

Where specified, the key interlock shall consist of two or more identically keyed brass bolt locks. The bolt on the lock shall prevent the operation of the electrical equipment. One brass key shall be provided for each group of identical locks. The key shall be held captive when the lock is positioned to allow equipment operation.

2.5 INDICATING LIGHTS

Switchboard indicating lights shall be register type of the voltage specified. Bulbs shall be telephone type with a slide base.

2.6 NAMEPLATES

Nameplates shall be provided as specified in Section 16195, Identification for Electrical Systems.

PART 3 - EXECUTION

All accessories and devices shall be installed per the switchgear manufacturer's instructions.

END OF SECTION

SECTION 16195

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install identification for electrical apparatus and electrical Work. All labeling shall be submitted to the Engineer and the City of Atlanta for approval of nomenclature and label characteristic physical and visual properties.
- B. Related Sections:
 - 1. Section 16000, Electrical Power and Systems
 - 2. Section 16110, Raceways, Boxes, and Supports
 - 3. Section 16111, Conduit.
 - 4. Section 16121, Instrumentation and Communication Cable.
 - 5. Section 16123, Building wire and Cable.
 - 6. Section 16140, Wiring Devices.
 - 7. Section 16150, Electric Motors.
 - 8. Section 16165, Disconnect Switches.
 - 9. Section 16515, Adjustable Frequency, Controlled Speed, Drive Systems.
 - 10. Section 16960, Control Circuits and Pilot Devices.

1.2 QUALITY ASSURANCE

Regulatory Requirements: Comply with the following:

- A. NEC Article 110, Requirements for Electrical Installation.
- B. NEC Article 210, Branch Circuits.
- C. NEC Article 215, Feeders.
- D. NEC Article 504, Intrinsically Safe Systems.
- E. NEC Article 700, Emergency Systems.
- F. NEC Article 701, Legally Required Standby Systems.
- G. NEC Article 702, Optional Standby Systems.
- H. 40 CFR 1910.145 (OSHA) – Specification for Accident Prevention Signs and Tags.
- I. NFPA 70E, Electrical Safety in the Workplace.

1.3 SUBMITTALS

Action Submittals: Submit the following:

- A. Shop Drawings: Submit the following:
 - 1. Complete description and listing of proposed electrical identification and electrical identification devices for associated equipment or systems.
 - 2. Conduit and wire identification numbering system and equipment signage.
- B. Product Data:
Manufacturer's literature, cut sheets, specifications, dimensions and technical data for all products proposed under this Section.
- C. Electrical Numbering System:
Refer to section 16000 1.9 for City Standard Electrical Numbering system

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Engraved Identification Devices (Nameplates and Legend Plates):
 - 1. Nameplates:
 - a. Laminated thermoset plastic, 1/16-inch thick, engraved condensed block black lettering on white background, square corners, and beveled front edges, or match existing.
 - b. Size: As required.
 - c. Letter Size: Minimum 3/16-inch.
 - 2. Legend Plates:
 - a. Legend plates for pushbuttons, pilot lights, selector switches, and other panel-mounted devices shall be large size with dimensions of approximately 2-7/16 inches wide by 2-13/32 inches tall (Allen Bradley large automotive size), plastic, custom engraved with black letters on white background.
Provide standard-size legend plates where devices are mounted on motor control centers and spacing of devices precludes using automotive-size legend plates.
 - b. Lettering size and line weight shall be the same for all legend plates on the same panel or enclosure. Maximum size shall be 1/4-inch and minimum size shall be 1/8-inch.
- B. Safety Signs and Voltage Markers:
 - 1. Provide high voltage signs for equipment operating over 600 volts.
 - 2. High-Voltage Safety Signs for Outdoor Applications:
 - a. Products and Manufacturers: Provide one of the following:
B-120-45471 by Brady.
Or equal.

- b. Unless otherwise shown or indicated, high voltage safety signs shall be not less than 10 inches high by 14 inches wide, of fiberglass reinforced plastic, and shall comply with 40 CFR 1910.145. Signs shall resist fading from exposure to temperature extremes, ultraviolet light, abrasive, and corrosive environments, and shall read, “DANGER – HIGH VOLTAGE – KEEP OUT”
 - c. Mounting hardware shall be Type 316 stainless steel.
 - 3. High-Voltage Safety Signs for Indoor Applications:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) B-302-84084 by Brady.
 - 2) Or equal.
 - b. High voltage safety signs for installation on indoor equipment shall be either pressure-sensitive acrylic or vinyl, and shall be not less than 10 inches high by 14 inches wide, shall comply with 40 CFR 1910.145, and shall read, “DANGER – HIGH VOLTAGE – KEEP OUT”.
 - 4. Low-Voltage Safety Signs:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) B-302-86060 by Brady.
 - 2) Or equal.
 - b. Low voltage safety signs shall be pressure-sensitive vinyl complying with 40 CFR 1910.145, five inches by 3.5 inches in size, and shall read, “DANGER – 480 VOLTS”.
 - 5. Low-Voltage Markers:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) CV442xx by Brady.
 - 2) Or equal.
 - b. Low voltage markers shall be either pressure-sensitive vinyl or vinyl cloth with black lettering on white background and shall read, “120 VOLTS”, “208 VOLTS”, “120/208 VOLTS”, or “240 VOLTS” as required.
- C. Arc-flash Safety Signs:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Brady.
 - b. Or equal.
 - 2. Warning signs shall be adhesive-backed polyester.
 - 3. Warning signs shall read, “Warning – Arc Flash and Shock Hazard. Appropriate PPE Required.” Arc flash warning signs shall indicate the flash protection boundary, incident energy in calories per square centimeter, hazard level, description of required protective clothing, shock hazard, limited approach boundary, restricted approach boundary, prohibited approach boundary, and equipment name.

D. Voltage System Identification Directories:

1. General:

- a. Directories shall be laminated thermoset plastic, 1/16-inch thick, engraved block black letters on white background, square corners, and beveled front edges.
- b. Directories shall identify all voltage systems within building or structure.
- c. Directories shall list the colors that identify ungrounded and grounded conductors of each system.
- d. Colors shall be in accordance with Section 16120, Low Voltage Electrical Power Conductors and Cables.
- e. Example Directory Text:

Voltage System Identification		
System	A, B, C	Neutral
277/480	Brown, Orange, Yellow	Gray
120/208	Black, Blue, Red	White

2. Large directories for rooms shall have text height not less than 1/2-inch.
3. Small directories for equipment shall have text height of not less than 1/4-inch.

E. Conduit Labels:

1. Products and Manufacturers: Provide one of the following:
 - a. B-915 by Brady.
 - b. Or equal.
2. Shall be pre-tensioned acrylic/vinyl construction coiled to completely encircle conduit for conduit up through five-inch diameter, or pre-molded to conform to circumference of conduit six-inch diameter and larger.
3. Attach strap-on style for six-inch diameter conduit with stainless steel springs.
4. Shall be blank for use with custom printed labels.
5. Custom Labels:
 - a. Shall have black lettering on yellow background.
 - b. Shall not contain abbreviations in legend.
 - c. Shall be custom printed on continuous tape with permanent adhesive using thermal printer specified below.
6. Approval by ENGINEER is required for any other labeling method.

F. Wire Identification:

1. Heat Shrinkable Wire and Cable Labeling System:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) B-341 PS-xxx-2W by Brady.

- 2) Or equal.
 - b. White heat-shrinkable irradiated polyolefin shrink-on sleeves. Labels shall be thermal printed. Labels shall be not less than two inches wide.
 2. Wrap-Around Wire and Cable Labeling System:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) THT-XX-427 by Brady.
 - 2) Or equal.
 - b. Self-laminating white/transparent self extinguishing vinyl strips. Length shall be sufficient to provide at least 2.5 wraps. Labels shall be thermally printed and not less than two inches wide.
 3. Approval by ENGINEER is required for any other labeling method.
- G. Detectable Underground Warning Tape:
1. Products and Manufacturers: Provide one of the following:
 - a. Indentoline by Brady.
 - b. Or equal.
 2. Material: Polyethylene or polyester with detectable metal core and polyester underlamine.
 3. Width: Two inches.
 4. Color and Labeling: Yellow or red with permanently imprinted black letters: "CAUTION – Buried Electric Line", repeated continuously over full length of tape.
- H. Thermal Printing System:
1. Utilize thermal transfer process to provide non-smearing labels and markers.
 2. Wire and Cable Markers:
 - a. Portable, Products and Manufacturers: Provide one of the following:
 - 1) TLS2200 by Brady.
 - 2) Or equal.
 - b. Desktop, Products and Manufacturers: Provide one of the following:
 - 1) 200M by Brady.
 - 2) Or equal.
 3. Cable Markers:
 - a. Portable, Products and Manufacturers: Provide one of the following:
 - 1) Handimark by Brady.
 - 2) Or equal.
 - b. Desktop, Products and Manufacturers: Provide one of the following:
 - 1) Labelizer PLUS by Brady.

- 2) Or equal.

2.2 FABRICATION

Engraved Identification Devices (Nameplates and Legend Plates):

Nameplate and legend plate text is preliminary and subject to change pending final review and approval of nomenclature by ENGINEER and the City of Atlanta after start-up and testing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide electrical identification in accordance with manufacturer recommendations and as required for proper identification of equipment and materials. All identification nomenclature shall be pre-approved by the Engineer and the City of Atlanta. In the event of any conflict between the labeling required by this section and labeling indicated in the Instrumentation and Controls, Div. 17 Specifications, obtain clarification and approval of the Engineer and the City before preparing the labels. Any labels provided, resulting in non-observance of this section may result in the request for preparation of a replacement label to be approved by the Engineer and the City, at no additional cost to the City.
- B. Engraved Identification Devices (Nameplates and Legend Plates):
1. Unless otherwise indicated in the Contract Documents, attach permanent nameplates with permanent adhesive and with 3/16-inch diameter, round head, stainless steel machine screws into drilled and tapped holes.
 2. Provide nameplate with 1.5-inch high letters to identify each console, cabinet, panel, or enclosure as shown or indicated.
 3. Provide nameplates for field-mounted motor starters, disconnect switches, manual starter switches, pushbutton stations, and similar equipment operating components, which shall describe motor or equipment function and circuit number.
 4. Provide nameplates with 1/2-inch high letters to identify each junction and terminal box shown or indicated.
 5. Except conduit, all electrical appurtenances including lighting panels, convenience outlets, fixtures, and lighting switches, shall be provided with nameplates indicating appropriate circuit breaker number(s).
 6. Push Buttons:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
 - c. Provide red buttons for stop function.

- d. Provide black buttons for other functions.
- 7. Pilot Lights:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
 - c. Shall have lens colors as shown or indicated. Where no color is indicated, provide the following lens colors:

Color	Legend
Green	Stopped, Closed
Red	Running, Open
Amber	Alarm
Blue	Power
White	Status

- 8. Selector Switches:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
- 9. Panel Mounted Instruments:

Provide nameplates for identification of function.
- 10. Interiors of Cabinets, Consoles, Panels, Terminal Boxes, and Other Enclosures:
 - a. Provide nameplates for identification.
 - b. Provide each item inside cabinet, console, panel, terminal box, or enclosure with laminated plastic nameplate as shown on approved Shop Drawings and CONTRACTOR's other submittals. Install nameplates with adhesive.
 - c. Interior items requiring nameplates include:
 - 1) Terminal blocks and strips.
 - 2) Bus bars.
 - 3) Relays.
 - 4) Rear of face-mounted items.
 - 5) Rear of door-mounted items.
 - 6) Interior mounted items that require identification when mounted externally.
 - d. Circuit Breaker Directory:

Provide engraved laminated plastic directory listing function and load controlled for each circuit breaker within panel used for power distribution.
- 11. Re-label existing equipment whose designation have changed.

C. Safety Signs and Voltage Markers:

- 1. Provide safety signs and voltage markers on and around electrical equipment as shown or indicated.
 - a. Install rigid safety signs using stainless steel fasteners.

- b. Clean surfaces before applying pressure-sensitive signs and markers.
- 2. Install high voltage safety signs on all equipment doors providing access to uninsulated conductors, including terminal devices, greater than 600 volts.
- 3. Provide cable tray safety signs on both sides of cable trays at maximum intervals of 20 feet. Install signs on side rails of tray as acceptable to ENGINEER.
 - a. Label cable trays that contain conductors greater than 600 volts with cable tray safety signs.
 - b. Cable trays that contain conductors greater than 208 volts and less than 600 volts shall be labeled with low voltage safety signs.
 - c. Cable trays that contain conductors of 120/208 volts shall be labeled with low voltage markers.
 - d. Do not label cable trays that contain only instrument signal cables.
 - e. Label cable trays that contain intrinsically safe wiring or cables in accordance with NEC Article 504.
- 4. Install low voltage safety signs on equipment doors that provide access to uninsulated 480-volt conductors, including terminal devices.
- 5. Install low voltage markers on each terminal box, safety disconnect switch, and panelboard installed, modified, or relocated as part of the Work and containing 120/208 volt conductors.

D. Voltage System Identification Directories

- 1. Provide voltage system identification directories as required by NEC Article 210 and NEC Article 215.
- 2. Provide in each electrical room voltage system identification directory mounted on wall or door at each entrance to room.
- 3. For panelboards, switchboards, motor control centers, and other branch circuit or feeder distribution equipment that are not located in electrical rooms, provide voltage system identification directory mounted on equipment.
 - a. Directories shall be affixed using epoxy glue. Screws or bolts shall not penetrate equipment enclosures.
 - b. Directories shall be readily visible and not obscure labels and other markings on equipment.

E. Arc-flash Safety Signs:

- 1. Provide arc-flash safety signs as required by NEC Article 110.
- 2. Provide signs for switchboards, panelboards, motor control centers, and industrial control panels. Provide signs for control panels that contain 480 volt equipment. Provide arc flash warning signs on

other equipment where the incident energy is greater than 1.2 calories per square centimeter.

F. Conduit Labels:

1. Provide conduits with conduit labels unless otherwise shown or indicated.
2. Do not label flexible conduit.
3. Do not label exposed single conduit runs of less than 25 feet between local disconnect switches and their associated equipment, where entire length can be seen..
4. Conduit labels shall indicate the following information:
Conduit Number: Alphanumeric as shown on the Drawings, as assigned by CONTRACTOR for unlabelled conduits, and in accordance with approved submittals.
5. Conduits that contain intrinsically safe wiring shall have an additional pipe marker provided that has blue letters on white background and reads, "INTRINSICALLY SAFE WIRING".
Install intrinsically safe pipe markers in accordance with NEC Article 504 along entire installation. Spacing between labels shall not exceed 25 feet.
6. Provide conduit labels at the following locations:
 - a. Where each conduit enters and exits walls, ceilings, floors, or slabs.
 - b. Where conduit enters or exits junction boxes, cabinets, consoles, panels, or enclosures, except pull boxes and conduit bodies used for pull boxes.
 - c. At maximum intervals of 50 feet along length of conduit.
7. Orient conduit labels to be readable.

G. Wire and Cable Identification:

1. Color-coding of insulated conductors shall comply with Section 16123, Building Wire and Cable.
2. Use heat-shrinkable wire labels where wire or cable is terminated. Use wrap-around labels where wire or cable is to be labeled but is not terminated.
3. Do not provide labels for the following:
Bare (uninsulated) conductors, unless otherwise shown or indicated as labeled.
4. Provide wire and cable labels for the following:
 - a. New, rerouted, or revised wire or cable.
 - b. Insulated conductors.
 - c. Wire and cable terminations:
 - 1) Wire labels shall be applied between 1/2-inch and one inch of completed termination
 - 2) Apply cable labels between 1/2-inch and one inch of cable breakout into individual conductors.

- Label individual conductors in a cable after breakout as specified for wires.
- d. Wire or cable exiting cabinets, consoles, panels, terminal boxes, and enclosures.
Label wires or cables within two inches of entrance to conduit.
 - e. Wire or cable in junction boxes and pull boxes
Label wires or cables within two inches of entrance to conduit.
 - f. Wire and cable installed in cable tray.
Wire and cable shall have labels at maximum intervals of 20 feet.
 - g. Wire and cable installed without termination in electrical manholes.
Wire and cable shall have wrap-around labels applied within one foot of exiting manhole.
5. Wire and Cable Identification System:
- a. Wire and cable labels shall be imprinted with an identifying designator.
Wire and cable extending between two devices or items and that does not undergo a change of function shall be identified by a single unique designator as specified below.
 - b. Field Wiring:
Wire or cable designator shall consist of:
 - 1) Three left-most characters shall consist of the Contract number under which wiring or cable was installed.
 - 2) Fourth character from the left shall be an asterisk (*), a plus sign (+) or a hyphen (-). Do not use other punctuation symbols in a wire designator.
 - 3) Remaining characters shall be alphanumeric and make wire designator unique.
 - 4) Numbering shall reflect actual designations used in the Work and shall be documented in record documents.
 - c. Cabinet, Console, Panel, and Enclosure Wiring, Internal:
New Cabinets, Consoles, Panels, and Enclosures:
Wire and cable inside cabinets, consoles, panels, and enclosures shall have designators as specified in Section 17000, Instrumentation and Controls for Process Systems.
6. Modified Cabinets, Consoles, Panels, and Enclosures:
New or rerouted wire or cable in existing cabinets, consoles, panels, and enclosures shall be labeled as shown on the Drawings or be assigned a ten-character designator equivalent to field wire designator.

- H. Terminal Strip Labeling:
1. Label panel side of terminal to match panel wire number.
 2. Label field side of terminal to match field wire number. Terminal number shall not include the Contract number.

+++ END OF SECTION 16195 +++

SECTION 16215

ELECTRICAL POWER DISTRIBUTION SYSTEM STUDIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, professional services, and incidentals required to perform electrical power distribution system studies.
2. Motor starting and transformer information used in electrical power distribution system studies shall be based on equipment provided by CONTRACTOR and, where applicable, existing equipment ratings and settings.
3. Electrical power distribution system studies shall include the following, as specified in this Section:
 - a. Short-circuit study.
 - b. Protective device evaluation study.
 - c. Protective device coordination study.
 - d. Arc flash analysis.

B. Related Sections:

Section 16195, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/IEEE C37.91, Guide for Protective Relay Applications to Power Transformers
2. ANSI/NCSL Z540.3 Requirements for the Calibration of Measuring and Test Equipment.
3. IEEE 141, Recommended Practice for Electric Power Distribution in Industrial Plants (IEEE Red Book).
4. IEEE 242, Recommended Practice for Protection and Coord. of Industrial and Commercial Power Systems (IEEE Buff Book).
5. IEEE 399, Analysis (IEEE Brown Book), Recommended Practice for Power System Analysis.
6. IEEE 1584, Guide for Performing Arc-Flash Hazard Calculations.
7. NFPA 70E, Electrical Safety in the Workplace.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Professional Engineer:
 - a. Engage a registered professional engineer with GA Registration legally qualified to practice in the jurisdiction where the Project is located and

experienced in providing engineering services of the kind indicated. Professional engineer may be employed by independent consulting firm or manufacturer of power distribution equipment.

- b. Professional engineer shall have not less than five years of experience performing electrical power distribution system studies similar in scope and size to the studies required for the Project.
 - c. Submit qualifications data.
 - d. Responsibilities include but are not necessarily limited to:
 - 1) Performing or supervising the performance of electrical power distribution system studies and related field services.
 - 2) Preparing or supervising the preparation of test plans and test reports, and interpretation and engineering analysis of test data. Test reports shall bear the seal and signature of the professional engineer. State of licensure, license number, and professional engineer's name shall be clearly legible on the seal.
 - 3) Certifying that tests performed and results achieved conform to the Contract Documents.
2. Field Engineer:
- a. Field engineer performing protective device testing shall be experienced in type of testing required and testing equipment used on the Project.
 - b. Field engineer may be an employee of the protective device equipment manufacturer.

- B. Test equipment and instrument calibration shall comply with accuracy standards of NIST and ANSI/NCSL Z540.3.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:

- 1. Studies:
 - a. Calculations and results of the short-circuit study, protective device evaluation, and coordination studies in report format. Report shall be sealed and signed by the professional engineer retained for the studies. Submit preliminary reports (when specified) and final reports.
 - b. Time current curves for protective devices included within the power system studies.
 - c. Calculations and results of arc-flash analysis in report format sealed and signed by professional engineer retained for the studies. Submit preliminary reports (when specified) and final reports.
- 2. Testing Plan: Submit work plan for field testing. Submit and obtain ENGINEER's approval prior to performing tests. Plan shall indicate schedule of field testing, time frames for tests, and duration of equipment outage for testing. Submit shutdown requests for each outage in accordance with Owner's Operations.
- 3. Field Survey Plan: Submit work plan for field survey and data gathering prior to beginning work. Plan shall indicate the schedule of work, time frames for data

collection, and duration that equipment will be temporarily out of service. Submit shutdown requests for each outage in compliance with Owner's Operations.

B. Informational Submittals: Submit the following:

1. Test Reports:
 - a. Results of field testing.
2. Qualifications Statements:
 - a. Professional engineer.
 - b. Field engineer, when required by ENGINEER.

C. Closeout Submittals: Submit the following:

1. Final settings of protective devices. Submit compilation of final settings for each equipment lineup within 10 days of programming the associated protective devices.
2. Electronic Files:
 - a. Protective Devices:
 - 1) Settings for all microprocessor-based protective devices.
 - 2) Software versions used to program the protective devices.
 - b. Electrical Power Distribution System Studies:
 - 1) Upon ENGINEER's approval or acceptance, as applicable, of submittals required under this Section, submit for OWNER's use all electronic files developed for the Work under this Section associated with the approved or accepted, as applicable, submittal to ENGINEER.
 - 2) Electronic files submitted for OWNER's use shall become OWNER's property.
 - 3) Source files for power studies performed under this Section.

1.5 ELECTRICAL POWER DISTRIBUTION SYSTEM STUDIES

A. General:

1. Perform a current and complete short-circuit study, protective device evaluation study, and protective device coordination study for the Site's electrical distribution system. Perform studies in accordance with IEEE 141, IEEE 242, and IEEE 399.
2. Studies shall include all portions of high-, medium-, and low-voltage electrical power distribution systems, from the normal and alternate sources of power through low-voltage distribution system. Thoroughly cover in the study normal system operating method, alternate operation, and operations that could result in maximum fault conditions.
3. Perform a complete study to evaluate both new and existing devices, and include recommendations on required adjustments. Studies shall include both the normal utility supply and standby generator systems.
4. Promptly bring to attention of ENGINEER and OWNER problem areas and inadequacies in equipment.
 - a. Preliminary Short-circuit and Coordination Study: Base the evaluation on the worst case operating mode. Base the evaluation on estimated cable lengths, and proposed equipment and protective devices.

- b. Final Short-circuit and Coordination Study: Base the evaluation on utility-confirmed contribution. Evaluate the distribution system under each of the various operating modes. Base the evaluation on actual confirmed cable lengths, and installed equipment and protective devices.

B. Short-circuit Study:

1. Perform short-circuit evaluation using computer software specifically designed for such use.
2. Input data shall include electric utility company's short-circuit, single-, and three-phase contributions, with reactance/resistance (X/R) ratio, resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and other applicable circuit parameters.
3. Calculate short-circuit momentary duties and interrupting duties on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.
4. Short-circuit tabulations shall include symmetrical fault currents and X/R ratios. For each fault location, total duty on the bus and individual contribution from each connected branch, including motor back electro-motive force (EMF) current contributions, shall be listed with its associated X/R ratio.

C. Protective Device Evaluation Study:

1. Determine adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing short-circuit ratings of these devices with the available fault currents.
2. Apply appropriate multiplying factors based upon system X/R ratios and protective device rating standards.

D. Protective Device Coordination Study:

1. Perform study to select or to check selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and setting.
2. Overcurrent device settings estimated in the protective device coordination study shall provide complete, 100 percent selectivity. Selectively coordinate system such that only the device nearest a fault will operate to remove the faulted circuit. System selectivity shall be based on both the magnitude and duration of a fault current.
3. Study shall include all voltage classes of equipment starting at electric utility's incoming line protective device, down to and including medium- and low-voltage equipment. Phase and ground overcurrent and phase and ground fault protection shall be included, and settings for other adjustable protective devices.
4. Plot time-current characteristics of installed protective devices on appropriate log-log paper. Maintain reasonable coordination intervals and separation of characteristic curves. Provide coordination plots for phase and ground protective devices for complete system. Use sufficient curves to clearly indicate selective

coordination achieved through electric utility's main breaker, power distribution feeder breakers, and overcurrent devices at each major load center.

5. Show maximum of eight protective devices per plot. Appropriately title each plot and include the following information as required for the circuits shown:
 - a. Representative one-line diagram, legends, and types of protective devices selected.
 - b. Power company's relays or fuse characteristics.
 - c. Significant motor starting characteristics.
 - d. Parameters of transformers, magnetizing inrush and withstand curves in accordance with ANSI C37.91.
 - e. Operating bands of low-voltage circuit breaker trip curves, and fuse curves.
 - f. Relay taps, time dial and instantaneous trip settings.
 - g. Cable damage curves.
 - h. Symmetrical and asymmetrical fault currents.
6. Provide selection and settings of protective devices separately in tabular format listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. Provide a tabulation of recommended power fuse selection for all fuses in system.

E. Arc-Flash Analysis:

1. Conduct arc flash analysis after acceptance by ENGINEER of short-circuit study and coordination study. Perform arc flash analysis for each operating mode of the system, in accordance with IEEE 1584 and NFPA 70E.
2. Document the protection and calculation procedures and coordination review in testing report. Present analysis results in tabular format showing the following:
 - a. Bus and protection device name.
 - b. Bolted and arcing fault values.
 - c. Protective device trip times.
 - d. Arc flash boundary, working distance, and incident energy.
 - e. Required protective flame-resistant (FR) clothing class.

1.6 STUDY REPORT

- A. Summarize results of electrical power distribution system studies in a typed or computer-printed report that includes the following:
 1. Description, purpose, basis, written scope, and single-line diagram of power distribution systems evaluated.
 2. Tabulations of circuit breaker, fuses, and other equipment ratings versus calculated short-circuit duties. Evaluation of short-circuit calculations and identification of underrated equipment.
 3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, and fuse selection. Include an evaluation and discussion of logical compromises for proposed protection.
 4. Fault current tabulation including definition of terms and guide for interpretation.
 5. Tabulation of appropriate tap settings for relay seal-in units.
 6. Tabulation of equipment survey information.

- B. Electrical power distribution system studies report shall include a separate section addressing arc flash analysis. In addition to protection and calculation procedures, and coordination review and analysis results, report shall include protective device evaluation for each high-incident energy case to determine if adjustments can improve system performance relative to arc flash hazard level.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

- A. Coordinate with professional engineer performing the studies and assist professional engineer with collecting information necessary to complete the specified studies.
- B. Prior to performing studies, obtain information pertaining to existing system necessary for performing studies.

3.2 FIELD TESTING

- A. Provide protective device field testing in accordance with manufacturers' recommendations. Field testing shall be by CONTRACTOR's field engineer, after submittal of and ENGINEER's acceptance of electrical power distribution system studies. Field testing results shall be documented in a report that shall include final settings of protective devices.
- B. Field engineer shall provide necessary tools and equipment and adjust, set, calibrate, and test protective devices. Protective relays and meters in medium- and low-voltage equipment shall be set, adjusted, calibrated, and tested in accordance with manufacturers' recommendations and the coordination study. Provide minor adjustments, repairs, and lubrication necessary for proper operation.
- C. Electromechanical protective relays provided in accordance with the Contract Documents shall be set and tested for acceptance. Testing shall include visual and mechanical inspection. Testing shall include overcurrent time and pick-up tests.
- D. Solid state and multi-function trip devices shall be set, including required programming necessary for the protection required. Devices shall be checked, configured, and tested for setting and proper operation.

3.3 MAINTENANCE OF OPERATIONS

Field testing may require that certain equipment be temporarily taken out of service. CONTRACTOR shall perform the Work with due regard to the need of OWNER for continuance of operations and in accordance with sequencing required in the Contract

Documents, and in accordance with Owner's Operations. Submit testing procedures and schedules and obtain acceptance by ENGINEER prior to starting testing and related Work.

3.4 INSTALLATION

Provide personnel protective equipment labels in accordance with Section 16195, Identification for Electrical Systems.

Supplier Services: Provide training for OWNER's operation and maintenance personnel in personnel protection equipment. Provide at least eight hours of training, in accordance with General Conditions for Instruction of Operations and Maintenance Personnel.

END OF SECTION

SECTION 16289

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install surge protective devices (SPD).
2. SPDs furnished under this Section shall be ANSI/UL 1449 3rd Edition Type 2 integrating both surge suppression and high-frequency noise filtering suitable for use on low-voltage distribution systems.

B. Related Sections:

1. Section 16000, Electrical Power and Systems.
2. Section 16160, Panelboards.
3. Section 16450, Grounding.

1.2 REFERENCES

Standards referenced in this Section are:

- A. ANSI/UL 1449 3rd Edition, Surge Protective Devices.
- B. IEEE C62.11, Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)
- C. IEEE C62.41, Recommended Practice on Surge Voltages in Low-voltage AC Power Circuits.
- D. IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.
- E. UL 1283, Electromagnetic Interference Filters.

1.3 QUALITY ASSURANCE

A. Qualifications:

Manufacturer: Shall have at least five years experience manufacturing and servicing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of component manufacturer from a single SPD manufacturer.

2. SPD manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by SPD manufacturer.
- C. Regulatory Requirements: Comply with the following:
1. NEC 110.9, Requirements for Electrical Installations, Interrupting Rating.
 2. NEC 240.21, Overcurrent Protection, Location in Circuit.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Electrical and mechanical drawings for each type of unit, showing electrical ratings, dimensions, mounting provisions, connection details, and layout diagrams.
 - b. Components list and nameplate schedule.
 - c. Summary sheets with schedules of equipment.
 2. Product Data:
 - a. Manufacturer's technical information, including catalog information.
 - b. Manufacturer's technical specifications with assembly and component ratings.
- B. Informational Submittals: Submit the following:
1. Certifications:
Certification that SPD devices comply with standards referenced in this Section.
 2. Source Quality Control Submittals:
Report of results of testing and inspections performed at manufacturer's shop.
 3. Supplier Reports:
Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 4. Qualifications Statements:
Manufacture, when requested by ENGINEER.
- C. Closeout Submittals: Submit the Following
1. Operations and Maintenance Data:
Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

2. Warranty Documentation: Submit example warranty at time of shipment of the equipment. Include final warranty accepted by ENGINEER in the operations and maintenance manual for the equipment.

1.5 DELIVERY, STORAGE, AND HANDLING.

- A. Delivery:
Upon delivery, check for evidence of water that may have entered equipment during transit.
- B. Storage:
 1. Store SPD equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
 2. Protect equipment from corrosion and deterioration.

1.6 WARRANTY

Contractor shall warrantee the work in accordance with the General Conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Manufacturers: Provide equipment of one of the following:

- A. General Electric.
- B. Schneider Electric/Square-D Company.
- C. Eaton/Cutler-Hammer.
- D. Or equal.

2.2 EQUIPMENT

- A. General:
 1. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
 2. SPD shall comply with requirements of the following:
 - a. ANSI/UL 1449.
 - b. UL 1283.
 - c. IEEE C62.11, IEEE C62.41 and IEEE C62.45.
 3. SPD shall be suitable for operation under the following environmental conditions:
 - a. Relative Humidity: Zero to 95 percent, non-condensing.
 - b. Frequency: 47 to 63 Hertz.
 - c. Temperature: Zero to 149 degrees F.

4. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.
 5. SPD shall be suitable for internal and external mounting. Where shown on the Drawings, SPD shall be factory-mounted and integrated into distribution equipment specified under the following Sections:
 - a. Section 16160, Panelboards.
- B. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:
1. Line-to-line.
 2. Line-to-neutral.
 3. Line-to-ground.
 4. Neutral-to-ground.
- C. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.
- D. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.
- E. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

Modes	208Y/120	480Y/277
L-N,L-G, N-G	800	1200
L-L	1200	2000

- F. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

Category	Application	Per Phase	Per Mode
C	Service entrance	240 kA	120 kA
B	High exposure locations (distribution equipment)	160 kA	80 kA
A	Branch locations	120 kA	60 kA

2.3 ACCESSORIES

Provide SPD equipped with the following accessories:

- A. Surge counter with display for indicating the number of surges detected.
- B. LED indicators for monitoring device status.
- C. Audible alarm and silence switch for indicating an inoperative condition.
- D. Dry contacts, "Form C", for remote annunciation of unit status.
- E. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to switchgear, motor control center, panelboard, or other equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.
- F. Enclosure for each externally-mounted SPD: NEMA rating shall be as required for area classifications specified in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.

2.4 SOURCE QUALITY CONTROL

Perform manufacturer's standard factory tests on equipment. Tests shall be in accordance with IEEE C62.45 and ANSI/UL 1449.

PART 3 - EXECUTION

3.1 INSPECTION

Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install SPD at locations shown on the Drawings in accordance with equipment manufacturer's recommendations, Laws, and Regulations, and the Contract Documents. When not shown on drawings, power SPD for major equipment and panels shall be mounted external to the equipment protected. Follow manufacturer recommendations for minimum distance to protected equipment.

- B. Conductor length between suppressor and connection point shall be as short and as straight as possible.

END OF SECTION

SECTION 16291

REDUCED VOLTAGE MOTOR CONTROLLERS

Part 1: General

A. SECTION INCLUDES

- 1) This specification defines the minimum requirements for electronic reduced voltage Soft Starters.

B. REFERENCES

- 1) UL 508
- 2) NEC
- 3) CCC
- 4) Lloyd's Register
- 5) CE
- 6) Canadian Underwriters Laboratory (cUL)
- 7) ISO 9001
- 8) ISO14001

Part 2: Products

2.01 General Description

1. The soft starter shall be provided by the manufacturer in configuration suitable for panel mounting or wall mounting. All power devices and components must be inaccessible during routine maintenance or set-up.
2. The soft starter shall utilize a three-phase thyristor (SCR) bridge consisting of at least two SCR's per phase to control the starting and stopping of standard motors.
3. The soft starter shall provide current-feedback (closed-loop) control for linear acceleration without external feedback independent of motor load or type of application. The gating of the thyristors will be controlled in such a manner to ensure a smooth and stable acceleration ramp.
4. The soft starter shall operate by modulating the output voltage to maintain a user defined start current. Voltage ramp ("open loop") and current limiting (voltage clamping) type soft starts are not acceptable.
5. The soft starter shall utilize AAC (Adaptive Acceleration Control) which allows selection of different acceleration and deceleration profiles unique to application needs.
6. The soft start shall be controlled by a microprocessor that continuously monitors the current and controls the phasing of the SCR's. Analog control algorithms shall not be acceptable.
7. The soft starter shall have provisions for a shorting (shunt bypass) contactor to take SCR's offline when motor is up to full speed. While the shunt bypass contactor is closed, the soft starter shall continue to monitor the motor's current and all of the motor-protective functions shall be operable.

2.02 Motor Data

1. In order to limit demand charges and mechanical stress to the motor and power transmission mechanical equipment, the motor shall be rated so that the starting current is sufficient to start the driven load at a maximum of 3.5 X FLC.

2.03 Ratings

1. The soft start shall be designed to operate in an ambient temperature from 0 to 40°C. Ratings of up to 60°C shall be possible for applications in severe environments.
2. Storage temperatures range from –25 to 60°C.
3. Maximum relative humidity shall be 95% at 40°C, non-condensing.
4. The soft start shall be designed to operate in altitudes up to 3300 ft.
5. The soft start shall be capable of operations between +10% and –15% of nominal voltage ratings.
6. Mains Frequency shall be 50/60 Hz ($\pm 5\%$)
7. The soft start shall automatically adapt for operation at 50 to 60 Hz. Frequency tolerance shall be +2% to –5% when starting and between +2% to –5% during steady state operation.
8. The soft start shall be capable of supplying 350% of rated full load current for 15 seconds 4 time per hour at maximum ambient temperature. The manufacturer shall supply rating information and PC-based selection tools to determine the appropriate rating of the starter for the specific application. The contractor shall supply the appropriate data from the motor and driven load to the softstarter manufacturer.
9. The SCR's shall have a minimum P.I.V. rating of 1400VAC. Lower rated SCR's which require transient protection by MOV's are not acceptable.
10. The soft starter shall be provided with Nema 1 protection.

2.04 Adjustments and Configurations

1. All dialog functions, display units, remote functions, terminal blocks, configuration switches shall be accessible on the front of the control module. Exposure to control circuits during routine adjustments is prohibited.
2. Digital indication shall provide, as a minimum, the following conditions:
 - a. Soft start status - ready, starting, stopping, run.
 - b. Motor status - Current, Thermal status.
 - c. Fault status – Shorted SCR trip, Excess start time trip, Overcurrent trip, Motor thermistor trip, Phase imbalance trip, Supply frequency trip, Phase rotation trip, Instantaneous overload trip, Power circuit fault, Undercurrent trip, RS485 communications fault, EEPROM read/write failure, Softstart overtemperature.
3. A Graphical LCD user interface shall be utilized to configure the following operating parameters as required.

- a. Motor full load amps adjustable from 50 to 130% of the controller rating.
- b. Current limitation on starting adjustable from 100 to 600% of motor full load rating.
- c. Total start time adjustable from 1 to 180 seconds.
- d. Current limit adjustable from 100 to 600% of nominal motor current.
- e. Selectable Torque boost.
- f. Selection of freewheeling/coasting, soft stop, or DC braking.
- g. Adjustable soft stop current ramp time from 0 to 240 seconds.
- h. Braking torque level adjustable from 20% to 100% effectiveness.
- i. Adjustable Overload Class from 2 - 30
- j. Selectable automatic reset operation.
- k. Assignment of controller's inputs and outputs.
- l. Activation of phase reversal protection.
- m. Reset of motor thermal state.
- n. Return to factory default settings.
- o. Three form A output relays configurable for, line contactor, Run, Tripped, High current flag, low current flag, Output on, DC brake contactor.

2.05 Protection.

- 1. A microprocessor controlled thermal protection system shall be included which continuously calculates the temperature rise of the motor and soft start.
- 2. Circuit boards shall be conformal coated.
- 3. The soft start shall provide phase loss, phase reversal, under load, stall, and jam protection.
- 4. The integral protective features shall be active even if an external shorting contactor is used to bypass the SCR's during steady state operation.
- 5. Semiconductor fuses shall be used to provide protection of SCR's as required by UL.

2.06 Control Options.

- 1. The soft start's control circuit power supply shall be completely independent of its power circuit and adaptable to 24VDC or 240, 380 or 460 VAC 50 or 60Hz supply.
- 2. Adjustable Bus Bars shall allow for both top and bottom entry on units 450HP and above at 460V. Units less than 450HP at 460V have fixed bus bars for bottom entry.
- 3. The soft start shall accept control logic either by operator devices (push buttons, selector switches, etc.) wired directly to the unit or from external relay logic.
- 4. The soft starter shall be furnished with a smart card designed to support integration with pumping applications. The smart card can monitor pump pressure, pump flow, well depth and pump temperature.
- 5. The soft starter shall have the ability to reverse phases A and C in order to turn the pump in the reverse direction at startup or upon a contact closure.

Part 3: Execution

5.0 Start-up and Warranty

1. A factory-authorized service technician shall perform start-up on each soft starter. ("Start up" shall not include installation or termination of either power or control wiring.) The service technician shall perform start-up on up to 8 soft starters per day. Start-up costs provided with the bid shall include time and travel for the estimated number of visits required but shall not be less than at least one half-day with travel. Additional labor or return trips to the site shall be billed at Danfoss' published straight-time rates. Upon completion, a start up service report shall be provided.
2. Manufacturer shall provide 10-Years on-site warranty such that the owner is not responsible for any warranty costs including travel, labor, parts, or other costs for up to 10 Years from the date of manufacture of the Softstart. The available warranty shall cover all Soft starter failures including line anomalies – including lightning strikes, load anomalies, accidental exposure to moisture or corrosives and accidental collision of other physical damage; product misapplications, vandalism and chronic problems due to the misapplication are not covered.

5.1 Installation

1. The soft start shall be installed per the manufacturer specifications with a minimum clearance of 4 inches top and bottom when using soft starts below or equal to 200HP hp. Soft starts larger than 200 hp require 4 inches on the sides and 8 inches top and bottom.
2. A standard wiring diagram is available for making the appropriate electrical connections. For packaged starters, a complete set of installation and dimensional drawings will be available.

SECTION 16351

ACTIVE HARMONIC FILTER

Part 1 General

1.1 Summary

- A. **Scope:** Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for low voltage active harmonic filters (AHF) as required for the complete performance of the work, as herein specified.
- B. **Section Includes:** The work specified in this Section includes, the characteristics for a continuous duty Active Harmonic Filter (AHF) designed to reduce total demand distortion (TDD and total harmonic distortion (THD (V)) to levels less than 5%. The AHF will also be able to correct for linear displacement and to balance the incoming three-phase current.

1.2 References, Codes, and Standards

- A. **General:** The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
- B. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
 - 1. ANSI/IEEE 519-2014, "Guide for Harmonic Control in Electrical Power Systems."
 - 2. ANSI/IEEE C62.41-1991, "Guide for Surge Voltages in Low AC Power Circuits"
- C. **Canadian Standards Association (CSA):**
 - 1. CSA C.22.2 No. 14, "Industrial Control Equipment."
- D. **Underwriters Laboratories, Inc. (UL):**
 - 1. UL 508, "Standard for Industrial Control Equipment."

1.3 System Description

A. Performance Requirements:

1. General: The AHF shall incorporate a state of the art IGBT based inverter to draw energy from the line at some portion(s) of the 50/60 Hz cycle, store the energy at the capacitor bank of the system DC buss, and then deliver the stored energy at some other portion(s) of the cycle. The AHF will utilize digital signal processor technology to continuously monitor the incoming line current and instantaneously direct energy/current flow in and out of the inverter to effectively correct; harmonic distortion, linear phase displacement and to balance the incoming three-phase lines.
 - a. Limit the 2nd through the 51st order harmonic current to less than 5% TDD at each AHF installation point.
 - b. Limit the voltage distortion THD (V) added to the facility electrical system to less than or equal to 5% immediately to the line side of each AHF installation point
 - c. Power Factor: Near unity at each AHF installation point.
 - d. Three-Phase line current balancing: $\pm 3\%$ each AHF installation point.
 - e. Crest Factor Capability: 3.0
2. **Note:** The AHF shall not correct for distortion caused by equipment installed upstream of the system installation point or for incoming utility voltage distortion. The AHF installation point shall be defined as the installation point for the system input wiring and current sensors.

B. Environmental Service Conditions

1. Ambient Operation Temperature: 0° C to 40° C
2. Humidity: 0 to 95%, non-condensing
3. Altitude: Operate up to 1000 M (de-rated at higher altitudes)

1.4 Submittals

A. Action Submittals

1. Technical Brochure detailing the features of the AHF
2. Dimensional drawings with the size, installed weight, and heat dissipation for each size AHF provided
3. Installation wiring diagram for each AHF provided

1.5 Quality Assurance

- A. **Third Party Certification:** The AHF shall have the third party certification by Underwriters Laboratories (UL listing, USL, and CNL)
- B. **Manufacturer Qualifications:** The manufacturer shall have been engaged in the production of low voltage active harmonic filters of the types and sizes required for a minimum of 10 years.

1.6 Delivery, Storage, and Handling

- A. The AHF is to be delivered to the project site in the supplier's or manufacturer's original containers, labeled with the supplier's or manufacturer's name or product brand name

- B. Store AHF and accompanying materials in their original, undamaged packages and containers, inside a well-ventilated area, which is protected from weather, moisture, extreme temperatures, and humidity.
- C. Storage Temperature: -20° C to 60° C

1.7 Project Conditions

- A. **Environmental Requirements:** Prior to the installation of AHF ensure that workplace is weatherproof, environmental conditions are within specifications for the AHF, and all significant in the area of the AHF is completed.

1.8 Warranty

- A. **General:** Standard Factory Warranty shall be 10 years of 360 months from the date of shipment, or. This warranty covers defects in material and workmanship, lightning strikes, accidental collision. It does not cover misapplication or flood.

Part 2 Products

2.1 Manufacturers

- A. **Basis of Design:** The AHF specified shall be manufactured by the drive manufacturer. This specification is to establish a standard of quality for the design, function, materials, and appearance of the systems. Equivalent products by other manufacturers are acceptable, but they must be proven in the field upon final commissioning to meet or exceed all requirements of IEEE519 over a period of 30 days via recording meter.
- B. **Acceptable Manufacturers**
 - 1. Danfoss
 - 2. “Approved” Equal

2.2 Equipment Size & Ratings

- A. Active harmonic filter (AHF) shall be designed to operate from an input voltage of 480, 240, or 208 VAC, +12%, -15%, 3phase, 3 wire plus ground.
- B. AHF shall be designed to operate with a voltage frequency of 50 or 60 Hz, ±5 Hz.
- C. AHF efficiency shall be no less than 98% at full load with heat losses not exceeding more than 2% of the unit KVAR rating.
- D. AHF amperage output shall be 400 amperes. Additional units can be paralleled if the amount of harmonic correction needed for an installation exceeds the maximum current rating of the largest single AHF.
 - 1. Refer to section 2.3 B for additional details

- E. AHF shall include a door interlocked disconnect switch. The disconnect switch shall be lockable in the off position.
- F. AHF output shall be electronically current limited to 100% rms of system current rating.
- G. Fuses will provide redundant overload protection. Fuses shall be Class T rated at 200,000 AIC.

2.3 Active Harmonic Filter System

A. Enclosure:

- 1. AHF shall be provided in a NEMA Type 1 gasketed enclosure with air intake filters
- 2. Enclosed AHF systems rated for 50 amps through 200 amps shall be supplied in wall mountable enclosures with top or bottom cable entry. Each enclosed wall mountable system shall include a door interlocked disconnect switch, which is lockable in the off position, and lifting lugs to aid in installation
- 3. Enclosed AHF systems rated for 300 amps shall be supplied in a floor mount (freestanding) enclosure with top or bottom cable entry. Each enclosed floor mount system shall include a door interlocked disconnect switch, which is lockable in the off position, lifting lugs to aid in the installation, and shall be mounted on rails to facilitate lifting by pallet truck or forklift.

B. Function of AHF

- 1. In order to monitor the incoming line current, the AHF will utilize two current sensors mounted on phases A and B of the incoming line. A third current sensor shall be utilized on phase C if there are line to neutral single phase loads present on the load side of the system installation point. Scaling for different size current sensors will be programmable via the HMI remote interface and LCD touch screen.
 - a. The AHF shall inject the corrective current required to limit the 2nd through the 51st order harmonic current to less than 5% TDD at each AHF installation point as defined by ANSI/IEEE Standard 519-2014.
 - b. The AHF shall limit the voltage distortion THD (V) added to the facility electrical system to less than or equal to 5% immediately to the line side of each AHF installation point as defined in ANSI/IEEE Standard 519-2014.
 - c. Non-linear loads installed downstream of the AHF shall be equipped with line reactors rated for a minimum of 3% or have DC link chokes rated for a minimum of 4%. Both are not required.
 - d. The AHF will also have the capability to provide reactive current correction, and load balancing of the three phase lines. These functions will be field selectable via the HMI.
- 2. If the amount of harmonic correction needed for an installation exceeds the maximum current rating of the largest single AHF available from the manufacturer, then multiple systems may be installed in parallel with each other to achieve the required amount of harmonic correction.
 - a. AHF that are installed in parallel with each other will utilize the one set of current sensors to monitor the load current.
 - b. Up to six systems may be installed in parallel with each other.
- 3. The AHF shall use electronic current limiting technology for protection of the system in the case of an overload condition.

- a. In the case of an overload condition the AHF will electronically current limit its output to 100% rms of the system maximum current capacity.
 - b. The AHF will be designed to operate continuously while current limited at 100% rms of maximum capacity.
4. The AHF shall be equipped with a Standby/Power Saving function which will automatically disable the AHF inverter when the monitored load power drops below a user selected, pre-programmed level.
 - a. This function can be used for power savings, or to automatically disable the AHF when an alternate input (emergency) source is being utilized which does not require harmonic correction.
 - b. During the Standby/Power Saving mode the AHF inverter bridge will remain energized in order to prevent any time delay when the AHF is automatically re-enabled.
5. The AHF shall enable the user to select the desired harmonic current TDD% to be achieved.
 - a. This function can be accessed via the LCD front screen
6. The AHF shall enable the user to select the desired Power Factor to be achieved.
 - a. This function can be accessed via the LCD front screen
7. In the case of a shutdown due to AC line conditions, which are outside the specifications of the AHF, the system will be programmed to restart in a controlled manner once the AC conditions are within system specifications.
 - a. The AHF shall be able to record the last 1,856 reset events that include line occurrences and/or fault conditions. The AHF will have a battery backup memory feature that will enable the unit to store the reset event information in the event of a power failure, or if the unit is manually turned off.
 - (i) Reset event information shall include a message stating the reason for the shutdown and/or fault, which is date and time stamped
8. In the case of shutdown due to a fault condition, the AHF will be programmed to attempt an auto restart and resume normal operation.
 - a. If the AHF completes the preprogrammed number of restarts and the fault condition still exists then the system will not attempt to restart until the system is attended to manually.
 - b. The AHF shall be able to record the last 480 shutdown events that include AC line occurrences and/or fault conditions. The AHF will have a battery backup memory feature that will enable the unit to store shutdown event information in the event of a power failure, or if the unit is manually turned off.
 - (i) Shutdown event information shall include a message stating the reason for the shutdown and/or fault, which is date and time stamped, as well as RMS, and instantaneous, values for:
 1. AC line voltages
 2. AC line currents
 3. Load currents
 4. AHF currents
 5. AHF inverter currents

6. DC buss voltage
 7. Heat sink temperatures
 8. PC board temperatures
- c. The AHF shall be able to record FDR (oscilloscope) data for the last 100 shutdown events, which allows for the customer or manufacturer to plot data from the last 4 cycles. The AHF will have a battery backup memory feature that will enable the unit to store shutdown event information in the event of a power failure, or if the unit is manually turned off.
- (i) FDR Data information shall include a message stating the reason for the shutdown and/or fault, which is date and time stamped, as well as values for:
 1. AC line voltages
 2. AC line currents
 3. Load currents
 4. AHF currents
 5. AHF inverter currents

C. Customer Interface

1. Front Panel Interface
 - a. AHF shall incorporate 6" x 3.5" dust tight graphic color LCD touch screen display
 - b. The AHF LCD touch screen display shall enable the user to view detailed power quality information, before and after the system installation point, so that the end user can evaluate the effectiveness of the system. This detailed information shall include, but not be limited to, the following:
 - (i) Line Voltage
 - (ii) Line Frequency
 - (iii) Line current (amps) before and after AHF installation point
 - (iv) Line THD % before and after AHF installation point
 - (v) Harmonic current (amps) before and after AHF installation point
 - (vi) Line Kilowatts (KW), Kilovolt amperes (KVA), and Power Factor (PF) before and after AHF installation point.
 - c. The operating status of the AHF ("ON" or "OFF") shall be indicated towards the bottom of the LCD touch screen display on every operational display page.
 - d. Additional status information such as: normal operation, max. Load, reduced power factor mode, low AC line, and warning or diagnostic messages shall be displayed directly below the "ON" or "OFF" status information.
 - e. Miscellaneous AHF operating parameters shall also be viewable on the LCD touch screen display. These parameters shall include: system heat sink temperature, system PC board temperature, AHF currents, AHF % loading, AHF inverter currents, Internal DC buss voltage, and system internal supply voltages.
 - f. The LCD touch screen display shall enable the user to perform the following system functions by touching the appropriate icons.

- (i) Run
 - (ii) Stop
 - (iii) Menu (select)
 - (iv) Set Parameters
- g. The LCD touchscreen shall enable the user to view detailed historical data. This detailed information shall include, but not be limited to, the following:
 - (i) Most recent 480 shutdown records that include AC line occurrences and/or fault conditions
 - (ii) Most recent 1856 reset records that include AC line occurrences and/or fault conditions
 - (iii) FDR information shall include a message stating the reason for the shutdown and/or fault, which is date and time stamped, as well as values for:
 - 1. AC line voltages
 - 2. AC line currents
 - 3. Load currents
 - 4. AHF currents
 - 5. AHF inverter currents
- h. The AHF shall enable the user to save status history and FDR data to a flash drive from the front panel interface for data acquisition and troubleshooting.
 - (i) Status history information includes shall include a message stating the reason for the shutdown and/or fault, which is date and time stamped, as well as RMS, and instantaneous, values including:
 - 1. AC line voltages
 - 2. AC line currents
 - 3. Load currents
 - 4. AHF currents
 - 5. AHF inverter currents
 - 6. DC buss voltage
 - 7. Heat sink temperatures
 - 8. PC board temperatures
 - 9. Parameter data
 - 10. Most recent 480 shutdown records that include AC line occurrences and/or fault conditions
 - 11. Most recent 1856 reset records that include AC line occurrences and/or fault conditions
 - (ii) FDR information shall include a message stating the reason for the shutdown and/or fault, which is date and time stamped, as well as values for:
 - 1. AC line voltages
 - 2. AC line currents
 - 3. Load currents
 - 4. AHF currents
 - 5. AHF inverter currents

- i. The AHF shall enable the user to update firmware from the front panel interface with the use of a flash drive. (No computer or additional protocols required)
- j. The AHF shall have LED indicators on the front panel that clearly show the customer the following status information in case of LCD screen issues
 - (i) Power
 - (ii) Control Status
 - (iii) Power Status

2. **Ethernet Communications Interface**

- a. The AHF shall have ethernet communications interface that can be accessed at the system front panel.
- b. The AHF ethernet interface shall enable the user to configure the selectable system parameters, collect system diagnostic information, collect current system operational data, collect historical system operational data, and remotely enable or disable the system.
- c. The AHF ethernet interface shall also enable the user to collect detailed power quality information, before and after the system installation point, so that the end user can evaluate the effectiveness of the system. This detailed information shall include, but not be limited to, the following:
 - (i) Line Voltage
 - (ii) Line Frequency
 - (iii) Line current (amps) before and after system installation point
 - (iv) Line TDD % before and after system installation point
 - (v) Harmonic current (amps) before and after system installation point
 - (vi) Line Kilowatts (KW), Kilovolt amperes (KVA), and Power Factor (PF) before and after system installation point.
- d. The AHF ethernet interface shall also enable the user to collect and view detailed status history information, including:
 - (i) Current parameter information
 - (ii) Most recent 480 shutdown records that include AC line occurrences and/or fault conditions
 - (iii) Most recent 1,856 reset records that include AC line occurrences and/or fault conditions
 - (iv) Most recent 100 FDR records that include a message stating the reason for the shutdown and/or fault, which is date and time stamped, as well as values for:
 - 1. AC line voltages
 - 2. AC line currents
 - 3. Load currents
 - 4. AHF currents
 - 5. AHF inverter currents

- e. An optional Ethernet/IP or Modbus TCP module shall also be available

3. Status Contacts

- a. The AHF shall be equipped with three status relays for remote monitoring of the system. The relay contacts shall be rated for 1.0 amps @ 24 VDC or 0.5 amps @ 125 VAC. The first relay will be energized if the system is fully operational and correcting harmonics. The second relay will be energized if a diagnostic or warning condition is indicated. The third relay will be energized if the system is operating at maximum capacity.

4. Remote Enable/Disable Dry Contact Input

- a. The AHF shall be equipped with a remote enable/disable input which can be controlled by a dry contact or a switch. This feature will permit the operator to remotely enable or disable the system without having to utilize the serial, or Ethernet communications interface.

2.4 External Current Transformers

- A. AHF shall utilize two split core type current transformers mounted on the phases A and B to monitor the line current drawn by the load(s) A third CT shall be mounted on phase C if any line to neutral loads are present.
- B. AHF shall be equipped with a CT setup function which can automatically determine if the external currents transformers are installed on the correct phase and in the correct direction and alert the user of improper CT placement. Automatic correction for improper CT placement will also be possible.
- C. Current Transformers shall be rated at a minimum for the total rated rms current of the load at the system installation point and shall have an output of current of 5 amperes.
- D. Current Transformers rated for 400 Hz shall be used

2.5 Source Quality Control

- A. The manufacturer shall fully test the performance of the AHF at full current and voltage, while functioning as a harmonic correction system to assure compliance with equipment specifications herein. The AHF shall be factory tested under steady state and varying load conditions.

Part 3 Execution

3.1 Installation

- A. Preparation and installation of the AHF shall be in accordance with reviewed product data, final shop drawings, and manufacturer's written recommendations.
 - 1. Install low voltage active harmonic filters in accordance with the NEC and applicable local codes.

3.2 Field Quality Control

- A. Field inspection startup and testing shall be performed by a qualified technician from the manufacturer.
- B. Perform equipment startup and testing in accordance with the manufacturer's instruction manual.
- C. Document equipment nameplate information and startup/testing data on the manufacturer's recommended startup/test report.

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete installation of grounding system. All work shall be installed, adjusted and tested in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract Drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

Test Reports: Submit directly to the Engineer two copies of the test reports certified by the testing technician.

1.3 QUALITY ASSURANCE

Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. NEC, Article 250.
- B. IEEE 81-83.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to the site and stored in the area assigned.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ground rods shall be $\frac{3}{4}$ inch diameter by 10 feet long, copper-clad steel, Joslyn, or equal. Ground rods shall be sectional type with threaded type removable caps and coupler, where lengths greater than 10 feet are required.
- B. Conductors shall be stranded copper, except that No. 6 A.W.G., when installed bare, shall be solid. When installed in raceways, conductors shall have specified 600 volt insulation, color coded green.
- C. Exposed or accessible connections shall be made with copper or bronze grounding clamps, lugs, through-bolts, or other fittings specifically intended for such use such as grounding bushings, etc. Underground or other inaccessible connections shall be made by the exothermic welding process.
- D. Aluminum grounding materials will not be accepted.

PART 3 - EXECUTION

3.1 APPLICATION

Items to be grounded shall include, but not necessarily be limited to, the following:

- A. Steel building structures and all other above-ground metal structures.
- B. Metallic raceways.
- C. Electrical equipment enclosures.
- D. Electrical system neutrals, only, at the point of supply.
- E. Ground buses of switchboards, motor control centers, panelboards, etc.
- F. Grounding pole of all receptacles.
- G. Lighting fixture housings, outdoor metal light poles, etc.
- H. Motors and other electrically operated equipment.
- I. Outdoor metal fences.
- J. Telephone service equipment (provide grounding leads only).
- K. Lightning arresters (where required).

- L. Medium and/or high voltage structures, housings, hardware, cable shields, static wires, etc., where applicable, other than items which are Utility Company owned.
- M. Transformers.
- N. Any equipment likely to become energized due to a malfunction
- O. Ground grid systems with ground rod and water pipe connections.

3.2 INSTALLATION

The grounding installation shall conform with requirements indicated on the drawings and with the following:

- A. Ground rods shall be driven vertically with top of rod 4" below grade, except that, where solid rock is encountered, rods may be tilted or, where necessary, may be placed horizontally.
- B. Below grade grounding loops, mats and/or leads shall consist of 4/0 bare stranded copper cable not less than 2'-6" below the finished surface. Where indicated to be outside of building perimeter or other structure lines, foundation pads, etc., conductors shall be located not less than 3 feet, horizontally, outside of building foundations or from the edge of pads, etc.
- C. Grounding risers shall be properly located so as not to comprise an obstruction or hazard to vehicle or pedestrian traffic. Risers for grounding steel columns shall rise within the concrete piers but shall clear column base-plates. Connections to exposed columns shall be "CADWELD" or "THERMO-WELD" type, located approximately 12 inches above the finished surface, and shall be made to the web of H shapes and to the inner surface of channels or angles. Connections to furred or otherwise inaccessible columns shall be made by brazing or welding. Risers to floor mounted equipment, such as switchboard, motor control centers, etc., shall be accessibly located under the equipment and be connected with bolted lugs. At permanent walls risers intended for extension within the building shall rise into an adequately sized junction box, surface or flush mounted to match other wiring within the area, approximately 1 foot above the floor, from which it shall be extended as insulated wire in conduit to the item or items to be grounded. Risers for extension or connection by others shall be left with approximately 4 feet of conductor coiled.
- D. Grounding jumpers shall be provided between the building grounding system or the grounded building structure and every incoming metal underground cold water pipe, including all sprinkler risers where such exist.

- E. Size of grounding conductors shall not be less than called for on the drawings, and otherwise shall not be less than the following:
 - 1. 4/0 A.W.G. for all buried or otherwise inaccessible conductors.
 - 2. For grounding A.C. system neutrals, as required by N.E.C. Table 250-94.
 - 3. For raceway and equipment grounding, as required by N.E.C. Table 250-95.
 - 4. No. 2 A.W.G. where installed exposed.
 - 5. For grounding low voltage ground buses, as required by NEC Table 250-94.
- F. Grounding conductors, insulated and color coded green, shall be provided in all low voltage feeder and sub-feeder and branch circuit conduit runs, except low voltage service entrance conduit runs which contain a grounded neutral. These grounding conductors shall be connected to all metallic conduits by means of approved grounding bushings at all conduit terminations at the supply end of such circuits.
- G. Outdoor metal fences provided under this Contract shall be bonded in not less than 3 places to an underground 4/0 grounding conductor extending not less than 25 feet on each side of the overhead line with not less than 3 ground rods bonded thereto, one in the center and one at each extremity. Fences around outdoor electrical substations shall be bonded to the substation grounding loop or grid at each corner post, at each gate post, and otherwise at points not greater than 25 feet apart, with flexible bonding jumpers provided for each gate.
- H. Install sufficient ground rods in addition to code required grounding so that resistance to ground as tested by standard methods does not exceed 2 ohm unless otherwise accepted. Where more than one rod is required, install rods at least 10 feet apart.
- I. Provide a bare conductor through each ductbank, connected to manhole/handhole ground rod. Connect to building ground grid or equipment frame as applicable.
- J. Provide a logic ground for main computer and each PLC based local control panel separate from the power system ground. Route a 1/0 insulated copper conductor in a 3/4-inch conduit to a ground cluster outside the building.
- K. Were the manufacturer of equipment supplied from 120 volt instrument power panels requires an isolated ground, the Contractor shall provide an additional isolated ground conductor from the equipment through the instrument power panel for connection to a ground cluster outside the building. The isolated ground conductor shall have green insulation with a

yellow stripe and shall be run in the same raceway as the power and neutral conductors.

3.3 GROUNDING CONNECTIONS

- A. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade. Provide ground well, as shown on the Drawings to allow for inspection.
- B. Make connections of sections of outdoor ground mats (counterpoise) for substations or other equipment underground. Make connections of other grounding conductors generally accessible.
- C. In handholes and manholes, install ground rods with ends 4 to 6 inches above the floor with connections of duct bank grounding conductors fully visible and accessible.
- D. When making thermo welds, wire brush or file the point of contact to a bare metal surface. Use thermo welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint. For compression connectors, use homogeneous copper, anticorrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer's compression tool. Notify Engineer prior to backfilling any ground connections.
- E. Compression connectors shall be cast copper as manufactured by Thomas and Betts or equal.

3.4 EQUIPMENT GROUNDING

- A. Ground each piece of electrical equipment by means of a grounding conductor installed in raceway feeding that piece of equipment with copper wire sized in accordance with NEC. Grounding conductors installed in conduit furnished with green, 600-volt insulation.
- B. Connect transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.
- C. Connect two separate ground connections from ground grid to ground bus of switchgear assemblies, motor control centers and all outdoor substation

equipment. Ensure that each connection for item of equipment is from different section of ground grid.

- D. Install a separate grounding conductor from ground system to motors of 480 volts and higher, in addition to raceway system. Ground motor ground connection to motor frame, independent of mounting bolts or sliding base. Ground motor to nearest point on grounding system, unless otherwise indicated.
- E. Connect lightning arrestors to ground system by suitable conductors.
- F. Ground each street lighting standard by ground rod driven near base of standard, in accordance with requirements of NEC. Connect ground rods to grounding connector brought with street lighting feeder cable.
- G. Where lightning arrestors are furnished with electrical equipment and grounding connections are not inherently provided, ensure that suitable separate grounding conductor connects lightning arrestors with system ground.
- H. Bond service entrance equipment ground bus in each building to the ground grid with a #4/0 bare copper conductor.

3.5 FIELD TESTS

- A. Test in the Engineer's presence the ground resistance of the grounding system.
- B. The Contractor shall test the resistance of the grounding electrode system by the fall of potential method. The Contractor shall supply a Biddle No. 6322 Earth Tester, or equal, and make the test in the presence of the Engineer with grounding conductors disconnected. If the grounding electrode test resistance exceeds 1 ohm, the Contractor shall add ground rods or other grounding electrodes to the grounding electrode system until the grounding electrode test resistance is 3 ohms or less. Methods which change soil resistivity are not acceptable as means of lowering the grounding electrode test resistance. This test shall not be made within 24 hours after rainfall.
- C. Test all ground fault circuit interrupter (GFCI) receptacles and circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.
- D. Provide copies of reports of all grounding system tests for inclusion in Operation and Maintenance Manuals and for review by the Engineer

END OF SECTION

SECTION 16451

DRY-TYPE LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install dry type low-voltage distribution transformers.
- B. Related Sections:
 - 1. Section 16000, Electrical Power and Systems.
 - 2. Section 16450, Grounding.
 - 3. Section 16195, Identification for Electrical Systems.

1.2 REFERENCES

Standards referenced in this Section are:

- A. NEMA ST-20, Dry Type Transformers for General Applications.
- B. NEMA TP-1, Guide for Determining Energy Efficiency for Distribution Transformers.
- C. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption for Distribution Transformers.
- D. UL 1561, Dry Type General Purpose and Power Transformers.

1.3 QUALITY ASSURANCE

Regulatory Requirements:

NEC Article 450, Transformers and Transformer Vault (Including Secondary Ties).

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Schedule of transformers to be furnished with ratings and other required technical data.
 - b. Proposed location for each transformer, including pad layout, dimensions, and appurtenances.
 - 2. Product Data:

Supplier's technical information for transformers proposed for use.

1.5 WARRANTY

Contractor shall warrantee the work in accordance with the General Conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dry Type Two-Winding Transformer:

1. Type: Dry type, air cooled, low temperature rise. Transformers 15 kVA and larger shall be energy efficient, complying with NEMA TP-1 Class 1 efficiency levels. Transformers less than 15 kVA shall be general purpose.
2. Rating: KVA, primary voltage and connection, secondary voltage and connection, frequency and number of phases shall be as shown on the Drawings.
3. Insulation: Insulation and average winding temperature rise (in a 40 degree C maximum ambient) for rated kVA per the following table. Energy efficient transformers shall be capable of 15 percent continuous overload at 150 degrees C temperature rise.

kVA Rating	Insulation Class (degrees C)	Temperature Rise (degrees C)
1 to 15 kVA	185	115
25 to 500 kVA	220	115

4. Winding Taps, Transformers 15 kVA and Less: Two 5-percent below rated voltage, full capacity taps on primary winding.
5. Winding Taps, Transformers 25 kVA and Larger: Two 2-1/2-percent above rated voltage and four 2-1/2+ percent below rated voltage, full capacity taps on primary.
6. Basic impulse level shall be 10 kV.
7. Sound Level: NEMA ST-20 standard.
8. Enclosure: UL listed for the application.
9. Identification: Identify transformers in accordance with Section 16195, Identification for Electrical Systems, with the transformer number and voltages, connection data, kVA ratings, impedance, and overload capacity.
10. Transformers shall comply with NEMA ST-20, NEMA TP-1, NEMA TP-2, and UL 1561.
11. Transformers shall bear the label of the Underwriters' Laboratories, Inc.

B. Manufacturers: Provide products of one of the following:

1. Eaton.
2. General Electric Company.
3. Square D Company.
4. Siemens.

5. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

Examine the conditions under which the dry type transformers are to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on walls or floors at locations shown. Install floor mounted transformers on raised concrete bases. Provide sufficient access and working space for convenient and safe operation and maintenance.
- B. Mount transformers so that vibrations are not transmitted to the building structural parts and other equipment. Make connections to transformers with flexible conduit.
- C. Adjust tap settings to provide proper voltage at panelboards.
- D. Install dry type transformers in conformance with governing codes and manufacturer's instructions and recommendations, and the Contract Documents.
- E. Ground transformer in accordance to the National Electrical Code.

END OF SECTION

SECTION 16510
INTERIOR LUMINAIRES

PART 1 - GENERAL

1.1 SCOPE

This Section includes interior lighting Luminaire lamps, drivers and accessories. Luminaire include lamps and parts required to distribute the light, position and protect lamps and connect lamps to the power supply. Interior luminaires specified to be installed under this section should be erected, and placed in proper operating condition in full conformity with electrical drawings unless electrical engineer notes exceptions.

1.2 SECTION INCLUDES

- A. Interior L.E.D. luminaires.
- B. L.E.D. Drivers.
- C. L.E.D. Lamps.
- D. Luminaire accessories.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate dimensions and components for each luminaires that is not a standard product of the manufacturer.
- B. Product Data: Provide dimensions, ratings, and performance data.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation and Maintenance Data: Instructions for each product.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 and NFPA 101.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
- D. Listing and Labeling: Provide Luminaire and emergency lighting units that are listed and labeled for their indicated use on the Project.
 - 1. Special Listing and Labeling: Provide Luminaire for use in damp or wet locations, specifically listed and labeled for such use.
 - 2. The terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.
 - 3. Listing and Labeling Agency Qualification: A “Nationally Recognized Testing Laboratory” *NRTL) as defined in OSHA Regulation 1910.7.
- E. Manufacturer Qualifications. Firms experienced in manufacturing Luminaire that are similar to those indicated for this Project and that have a record of successful in-service performance.

1.5 RELATED SECTIONS

- A. Section 16100 – Basic Materials and Methods
- B. Section 16140 – Wiring Devices
- C. Section 16123 – Building Wire and Cable

1.6 REFERENCES

- A. NECA/IESNA 500 - Recommended Practice for Installing Indoors Commercial Lighting Systems; National Electrical Contractors Association; 2006.
- B. NECA/IESNA 502 - Recommended Practice for Installing Industrial Lighting Systems; National Electrical Contractors Association; 1999.
- C. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association; latest State of GA adopted Code edition.
- E. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; latest State of GA adopted Code edition.
- F. All standards codes and guidelines are subject to meeting the latest adopted or revised code or standard in effect for the State of GA by the time of construction Bid award.

1.7 WARRANTY

Special Project Warranty: Submit a warranty, mutually executed by manufacturer and the Installer, agreeing to replace rechargeable system batteries that fail in materials or workmanship within the special project warranty period specified below. This warranty is in addition to, and not a limitation of, other rights and remedies the Owner may have under the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton.
- B. Cooper.
- C. Crouse-Hinds.
- D. Engineer Approved Equal

2.2 L.E.D. LUMINAIRES

- A. Furnish products as indicated in Schedule on drawings.
- B. Light source: Light emitting diodes (LEDs).
- C. Construction: suitable for area classification indicated on Drawings.
- D. Finish: Corrosion resistant NEMA-4X suitable for area classification indicated on Drawings..
- E. Accessories: Provide luminaires complete with all installation accessories.

2.3 L.E.D. DRIVERS

- A. Luminaires shall be equipped with an L.E.D. driver(s) that accepts the voltage as indicated on the "Luminaire (Lighting Fixture) Schedule". Individual driver(s) shall be replaceable.
- B. Driver(s) shall be UL8750 class 2 compliant for their intended Purpose.
- C. Total harmonic distortion (THD) for current: $\leq 20\%$
- D. Driver(s) shall be rated to operate between -30°C to 50°C minimum.

- E. Driver(s) shall be equipped with surge protection (6kV minimum) in accordance with IEEE/ANSI C62.4.1. Driver shall be protected against damage due to either an open circuit or short circuit fault condition on the driver output.
- F. Driver(s) shall have a minimum efficiency of 85%.

2.4 L.E.D. LAMPS

- A. L.E.D. lamps shall be high-efficiency long-lifetime type.
- B. L.E.D. lamps shall have a minimum lifetime of 50,000+ hours at 40° C and shall have a minimum efficiency of 80 lumens per watt.
- C. L.E.D. lamps shall be tested in accordance with I.E.S.N.A. LM-80-08 standards.
- D. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps, or liquids.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Luminaire securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- B. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaires at indicated height.
- C. Install accessories furnished with each luminaires.
- D. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaires.
- E. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Section.
- B. Operate each luminary after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Aim and adjust luminaires as indicated.
- B. Position exit sign directional arrows as indicated.

3.4 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.5 TESTING, DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate luminaires operation for minimum of two hours.
- B. All testing shall be performed in accordance with the requirements of the General conditions and Division 1. The following Tests are required:
 - 1. Witnessed Shop tests
None Required
 - 2. Certified Shop Tests
The lighting Luminaire shall be given routine factory tests in accordance with the requirements of ANSI, NEMA and Underwriter Laboratories standards.

3.6 PROTECTION

Relamp luminaires that have failed lamps at Substantial Completion.

+++ END OF SECTION +++

SECTION 16515

VARIABLE FREQUENCY DRIVES - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Variable frequency drives (VFDs) for operation of inverter duty motors.

B. Related Specification Sections include but are not necessarily limited to:

1. Section 16195 – Identification for Electrical Systems.
2. Section 11000 – General Requirements for Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute (ANSI).
2. ETL Testing Laboratories (ETL).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
 - b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - c. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
4. National Electrical Manufacturer's Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. MG 1, Motors and Generators.
5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - i). Article 430, Motors Motor Circuits, and Controllers..
6. Occupational Safety and Health Administration (OSHA).
7. Underwriters Laboratory, Inc. (UL):
 - a. 508, Standard for Industrial Control Equipment.
 - b. 508A, Standard for Industrial Control Panels.

B. Qualifications:

1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequently field-labeled by such NRTL.
2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.
 - a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.
3. VFD Supplier shall maintain an authorized service organization within 300 miles of the Project Site.

C. Coordination:

1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.
 - a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and available floor space.
2. Motor and VFD coordination: See Specification Section 11000 and Specification Section 16195.
3. VFD shall be supplied complete with all required control components.
 - a. Provide control as indicated:
 - i). On the electrical drawings.
 - ii). As specified in this Specification Section.
 - iii). As specified in the process control system loop descriptions.
 - a) See Specification Section 17100.
 - b. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.
 - i). These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
 - c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.
4. Verify plan dimensions with equipment space requirements as indicated on the Drawings.
 - a. Equipment which exceeds the allotted maximum dimensions may not be acceptable.

- b. Equipment which reduces clear work space below the minimums established by the NFPA 70 will not be acceptable.

1.3 DEFINITIONS

A. Variable Torque (VT):

1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.
2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.

B. Constant Torque (CT):

1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.

C. Constant Horsepower:

1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.

D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.

E. Standard Motor: An AC induction motor that fails to comply with one or more requirements of NEMA MG 1 Part 31.

F. Low Voltage: 600 VAC or less.

1.4 SUBMITTALS

A. Shop Drawings:

1. Provide a schedule for each VFD including the following information:
 - a. Equipment Tag Number.
 - b. VFD Complete Catalog Number.
 - c. VFD Amp Frame Size.
 - d. Variable or Constant Torque Rating Basis.
 - e. Rated Input Current.
 - f. Rated Continuous Output Current.
 - g. Rated Short Circuit Current.
 - h. VFD cable type specified (shielded or non-shielded).
 - i. VFD Maximum Motor Lead Length for the type of cable used.

- j. Motor Manufacturer.
 - k. Motor Frame Size.
 - l. Motor Full Load Amps.
 - m. Motor Service Factor.
 - n. As installed motor Lead Length.
 - o. VFD options provided to meet harmonic or motor protection specifications.
2. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
 3. Product technical data:
 - a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
 - b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
 - c. Manufacturer's installation instructions.
 - d. Manufacturer's programming and operation instructions.
 4. Fabrication and/or layout drawings:
 - a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
 - b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
 - c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
 - d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.
 - e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
 - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
 5. Certifications:
 - a. Submit with Shop Drawings:
 - i). Identification and location of closest authorized service organization.
 - ii). Harmonic analysis at each PCC per Harmonic Protection Requirements Article.
 - b. Submit prior to shipment:
 - i). Certified factory test reports confirming compliance with specified requirements.
 - c. Submit after installation:
 - i). Certified field service reports showing:

- a) Each VFD is operational.
- b) Each VFD and its driven equipment motor are compatible.
- c) Each VFD responds correctly to the input control signals.
- d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.
- e) Measured harmonic levels per Harmonic Protection Requirements Article.
- f) Measured motor terminal peak voltages per Motor Protection Requirements Article.

B. Contract Closeout Information:

- 1. Operation and Maintenance Data
- 2. Approved copy of VFD schedule per Submittals Article.
- 3. Manufacturer's instruction manuals.
- 4. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.
- 5. Connection data to permit removal and installation of recommended smallest field- replaceable parts.
- 6. Recommended spare parts list.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Danfoss.
 - 2. Allen Bradley if space requirements are met.
 - 3. Toshiba if space requirements are met.

2.2 GENERAL

- A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse- width-modulated (PWM) output voltage waveform.
- B. VFDs, whether installed in motor control center (MCC) construction or separately-mounted, shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
 - 1. Motor control.
 - 2. Motor overload protection.

3. Motor and motor branch circuit short circuit and ground fault protection.
 4. Motor and controller disconnecting means.
- C. It is the intent of this Specification that VFDs shall be an “engineered” or “configured” drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory- assembled and -tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Application:

1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100 PCT of base speed of the driven equipment.
2. VFDs shall be compatible with:
 - a. Inverter duty induction motors.
3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
 - a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to identify CT and VT applications.
4. VFDs shall be designed to operate successfully under the following site conditions:
 - a. Ambient:
 - i). Temperature: 0-50 DEGC.
 - ii). 95 PCT non-condensing relative humidity.
 - b. Elevation: Less than 3,300 FT above MSL.
 - c. Power supply characteristics:
 - i). 480Vac, 3 PH, 60 Hz, 3 wire, (± 10 PCT).
 - ii). Effectively grounded.

B. Ratings and Performance Specifications:

1. Voltage rating:
 - a. Nominal: 460 or 480VAC, 3 PH, 60 Hz.
 - b. Range for continuous full load operation: ± 10 PCT of nominal.
 - c. Voltage imbalance tolerance for full load operation: 3 PCT minimum.
2. Current ratings:
 - a. Continuous:
 - i). Equal to or greater than the motor nameplate full load.
 - b. Short-term overload:

- i). VT: 110 PCT for 1 minute.
 - ii). CT: 150 PCT for 1 minute.
 - iii). Permissible for 1 minute every 10 minutes continuously.
 - c. Short circuit:
 - i). As indicated on the Drawings.
 - ii). Where a short circuit rating is not indicated or specified for individual VFDs, each VFD shall have a rating not less than indicated on the Drawings for the MCC, switchboard or panelboard the VFD is supplied from.
 - iii). Where specified short circuit rating indicates additional input impedance is required to protect semiconductors, provide input AC line reactors, whether required to meet harmonic performance specifications or not.
- 3. Efficiency:
 - a. 97 PCT, minimum, at full speed and full load.
 - b. 93 PCT, minimum at 1/2 speed and full load.
- 4. Displacement power factor:
 - a. 95 PCT, minimum from 50 PCT to 100 PCT speed and load.
- 5. Efficiency and power factor criteria apply from the input terminals to the output terminals of the VFD alone, excluding losses of input and output power circuit accessories.
- 6. Frequency drift:
 - a. +0.5 PCT of set frequency.
- 7. Speed regulation (motor dependent): 3 PCT.
- 8. Speed range: 10:1.
- 9. Control type:
 - a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
 - i). When operating under voltage boost.
 - ii). At frequencies over 60 Hz.
- C. Operational Features:
 - 1. Insensitive to input phase sequence.
 - 2. Continued operation with momentary voltage dips of 25 PCT of rated voltage, or single phase condition: 4 SEC, minimum.
 - 3. Controls power loss ride-through: 500 MSEC, minimum.

4. Electronic reversing.
 5. DC injection braking.
 6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting load, forward or reverse.
 7. Critical frequency band lockout:
 - a. Minimum of three settings.
 - b. Adjustable bandwidth, 1 - 5 Hz.
 8. Capable of operating without the motor connected for start-up and troubleshooting.
- D. The VFD shall be provided with the following minimum user-programmable parameters:
1. Carrier frequency.
 2. Independent maximum and minimum speeds for forward and reverse operation.
 3. Start frequency and hold time.
 4. Independent linear acceleration and deceleration time.
 5. Preset "jog" speed.
 6. Three critical frequency bands.
 7. One preset speed selectable by logic input.
 8. Volts/Hertz ratio.
 9. Voltage boost, magnitude and frequency range.
 10. Process controller gain, offset and bias.
 11. Current limit.
 12. Overcurrent pickup.
 13. Overcurrent delay.
 14. Ground fault pickup.
 15. DC injection level and time.
- E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
1. General:
 - a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:
 - i). Input under voltage.
 - ii). Input over voltage.

- iii). Input under frequency.
 - iv). Input over frequency. v).
 - Input Phase loss.
 - vi). DC Bus under voltage.
 - b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.
 - i). Over temperature.
 - ii). Blown fuse.
 - iii). Component failure. iv).
 - Overload.
 - v). Short circuit. vi).
 - Ground fault.
 - vii). DC Bus over voltage.
 - viii). External safety input (e.g., motor thermal protection).
 - ix). Logic fault.
 - c. When automatic shutdown occurs, VFD shall restart only when remote run signal is removed and reapplied.
 - d. VFD shall hold cause of trip data for a minimum of four shutdowns in memory.
 - i). Data to be accessible through the keypad, local communication link and remotely.
2. Input protection:
- a. Input circuit breaker or current-limiting fuses with externally operable disconnect.
 - i). i). Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
 - ii). Handle padlockable in the OFF position.
 - b. Provide full protection for semiconductors integral to the VFD; units requiring current- limiting fuses or circuit breakers in the supply circuit are not acceptable.
 - c. Incoming line transient suppression.
 - i). 6000V peak per IEEE C62.41.
 - ii). Phase-to-phase and phase-to-ground protection.
 - d. Sustained over voltage trip.

3. Internal protection:
 - a. Surge suppression and power device snubbers.
 - b. Power devices rated at 2.5 times line voltage.
 - c. Instantaneous over current trip.
 - d. DC bus over voltage trip.
 - e. Power device over temperature trip.
 - f. Control logic circuit malfunction trip.

4. Output protection:
 - a. Inverse-time overload trip:
 - i). UL Class 10 characteristic.
 - b. Over voltage trip.
 - c. Over frequency trip.
 - d. Short circuit trip.
 - i). Line to line and line to ground.
 - e. Ground fault trip.

2.4 OPERATOR AND REMOTE CONTROL INTERFACE

- A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
 1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.
- B. Control circuits shall be 120 VAC or 24 VAC or 24 VDC.
 1. 120 VAC supplied by CPT in the VFD.
 - a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
 - b. CPT shall have two fuses on the primary side and one fuse on the secondary side.
 - c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
 2. 24 VAC or 24 VDC supplied by Class 2 power supply in the VFD.
 - a. Power supply shall have minimum additional capacity of 33 PCT greater than that required by control devices.
 - b. Provide two current-limiting fuses on the AC supply to the power supply.
 - c. Power supply shall have surge protection on the primary side independent of any other surge protection in the VFD.
- C. Operator Interface:
 1. Door mounted sealed keypad, membrane type with LED or LCD display.
 - a. Messages shall be in English and engineering units.

- b. Drive operating parameters shall be programmable.
 - c. Menu driven.
 - d. Password security.
 - e. Display fault and diagnostic data.
 - f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
 - g. Gold plated plug-in contacts.
 - 2. Provide indication and control interface, integral in the keypad, as required in the sequence of operation and Drawings.
 - a. Minimum indications:
 - i). Run.
 - ii). Stop. iii).
 - Ready. iv).
 - Alarm.
 - v). Fault.
 - vi). Local control. vii).
 - Remote control.
 - viii). Control source local. ix).
 - Control source remote. x).
 - Speed indication.
 - b. Minimum control functions: i).
 - Local/Remote switch.
 - ii). Stop button. iii).
 - Start button. iv).
 - Reset button.
 - v). Speed control buttons.
 - 3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
 - a. On occurrence of more than one condition, each shall be recorded or indicated by the diagnostics.
- D. Remote Control Interface:
- 1. Analog and discrete inputs:
 - a. Speed reference (setpoint) signal 4-20 mA DC.
 - b. Isolated process PID controller with user-programmable setpoint, gain, rate, reset and span for accepting a remote 4-20 mADC process variable signal.

2. Analog and discrete outputs:
 - a. 4-20 mA DC output for remote speed indication, as a function of frequency, calibrated 0 to 100 PCT.
 - b. Drive FAULT contacts.
 - c. Drive RUNNING contacts.
 - d. Drive selector switch in REMOTE status contacts.
3. Contacts:
 - a. Contacts shall be rated 2 A inductive at 120 VAC.
 - b. All contacts shall be wired to field wiring terminal boards.
4. Drive shutdown on external fault input:
 - a. Provide isolated input for dry contact from external motor or system safety devices to cause immediate shutdown of VFD.
 - b. Safety shutdown to be operable in all operating modes of drive, including local operation from keypad.
 - c. Local safety switch, to driven equipment, auxiliary contact to lock-out VFD from running when safety switch is open.
5. Network communications capability:
 - a. Provide VFD with communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
 - i). Ethernet IP.

2.5 HARMONIC PROTECTION REQUIREMENTS

- A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a “dedicated system” in IEEE 519 Table 10.2.
- B. With all VFDs operating under worst-case harmonic current conditions, and the facility supplied from either or both the utility and generator sources, the VFDs shall not produce harmonic effects in excess of the following limits at any point of common coupling (PCC).
 1. Voltage distortion and notch characteristics: IEEE 519 Table 10.2 for General System.
 2. Current distortion: IEEE 519 Table 10.3 based on calculated ISC/IL at each PCC.
- C. PCC shall be considered:
 1. Building service entrance switchgear, switchboard or MCC.
 2. Each MCC, switchboard, switchgear, or panelboard supplying a VFD branch circuit.

- D. The Engineer has performed preliminary calculations based on typical VFD data which indicate that the minimum mitigation measures required to meet the specified harmonic criteria are one of the following topologies:
 - 1. 6-pulse rectifier topology with input line reactors or DC link reactors, minimum impedance 5 PCT on drive kVA base.
 - 2. Active harmonic filter (specified elsewhere) at each PCC.
- E. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic distortion levels and mitigation techniques required to meet the specified limits and shall furnish the VFD types and all accessory items and equipment necessary to do so, whether specified herein or not.
- F. VFD manufacturer shall provide a harmonic analysis of the distribution system based on their proposed specific equipment characteristics and mitigation techniques confirming that the specified levels are not exceeded.
 - 1. Analysis shall be based on the methodology of IEEE 519-2014 and IEEE 399.
 - 2. Power system data for analysis shall be taken from the electrical drawings and approved equipment submittals.
 - a. VFDs provided in a package with equipment specified elsewhere, shall be included in the analysis.
- G. Following start-up, with facility at full load operation, provide measurement of harmonic voltage, current and notch characteristics at each PCC according to the requirements of IEEE 519 Section 9.
 - 1. Values in excess of specified limits require correction by contractor and re-measurement.
 - 2. Provide certification of compliant measurements as part of rvice Engineer's final Field Se report.

2.6 MOTOR PROTECTION REQUIREMENTS

- A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce rated torque at rated RPM continuously without exceeding the temperature rise given in NEMA MG 1 Table 31-2.
- B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.
- C. Input for RTD's, leak and vibration sensors.
- D. The VFD shall provide continuous, real time Condition Based Monitoring, to include but not limited to, the following;
 - 1. Vibration level monitoring. Having a vibration transmitter mounted and

connected to the drive, the drive shall perform advanced monitoring by correlating the transmitter signal with motor speed. The drive will detect faults and give early warning information on the health state of the system to prevent functional failure. The drive shall have a programmable learning period where baseline vibration signals are mapped motor versus speed, allowing the drive to learn what are “standard conditions”. Under normal operations, if the vibration threshold levels according to ISO10816 are exceeded, the drive shall be programmable for a warning or a fault condition, protecting the motor/pump/fan system.

2. Motor Stator Winding Condition. The drive shall monitor the condition of the motor stator windings, via the use of internal signal processing. Should a winding fault begin to develop, the drive will indicate a programmable warning and/or fault condition.
 3. Performance Envelope Monitoring. The drive, through internal signal processing, shall monitor the performance of the motor and the drive shall have a programmable learning period where it will develop a baseline load envelope. Under normal working conditions, should the drive detect the motor is operating outside of this established load envelope, the drive can be programmed to enter a warning and/or fault condition. This performance load envelope shall be monitored continuously and in real time, not requiring additional sensor devices.
 4. These Condition Based Monitoring functions shall function on their own, internal to the drive without the need for external cloud-based services. The drive shall have the capability to upload these performance variables to the Cloud, without requiring any fee-based subscription services.
- E. The VFD shall include a remote monitoring package that includes a remote gateway to continuously upload drive data to a cloud server to provide:
1. The ability to view real time drive settings, faults, performance KPIs in a web browser dashboard.
 2. Backup of drive parameters.
 3. Provisions for the manufacturer to log into the drives upon customer request to troubleshoot any issues.
 4. Automatic and immediate notification to an operator via email, text, or other means of a fault or warning condition.
- F. The VFD shall not produce voltage spikes in excess of the following values at the motor terminals when operated with the feeder types shown on the Drawings and the actual installed feeder lengths.
1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters, or other devices as required to meet the specified limits:
 - a. Inverter duty motors: 1280 V.

- b. Rise time shall be greater than or equal to 0.1 microsecond.
 - c. Motor lead length and data shall be determined by the Contractor based on the actual routing of the conductors
- G. Following start-up, provide measurement of peak voltage at the terminals of each motor, unless the lead lengths are 10 PCT shorter than the manufacturers published literature for maximum lead length for the type of cable installed.
 - 1. Values in excess of specified limits require correction by contractor and re-measurement.
 - 2. Provide certification of compliant measurements as part of Service Engineer's final Field Se report.

2.7 EQUIPMENT CONSTRUCTION

A. Fabrication and Assembly:

- 1. Each VFD system shall be factory-assembled in an enclosure for remote mounting, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.
 - a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
 - b. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or authorized agent will not be acceptable.
 - c. The arc-flash incident energy at the drives with the front cover open shall be 5.63 calories per mm² (PPE Category 1) or less by using active arc-flash relays in the upstream switchgear and point light sensors in each drive.
 - d. Reactors and/or filters, where required, shall be mounted within or in an ancillary enclosure adjacent to the drive enclosure, or with the Engineer's permission may be mounted in a separate enclosure.
 - e. Cooling fans, as required, shall be provided to run when drive is running.
 - f. The VFD shall be integrated onto an exterior wall of building or e-house to take advantage of back-channel cooling. 95% of the heat generated by the VFD shall be expelled into the outside air.
 - g. Where applicable, the e-house manufacturer shall provide an economizer or air-redirect method to adjust the amount of heat that is reintroduced into the e-house during winter conditions to maintain an interior temperature of 70 degrees Fahrenheit.
 - h. Enclosures for separately mounted VFD's shall be as required for the area classification indicated in Section 16100, Basin Electrical Materials and Methods, unless otherwise indicated on the Drawings.

B. Wiring:

1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
 - a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.
 - b. Bases with a self-sticking back will not be allowed.
2. All plug-in contacts shall be gold-plated.
3. Provide terminal boards for all field wiring and inter-unit connections, including analog signals.
 - a. Provide terminals for shield continuity where required.
4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
 - a. Non-brittle, interlocking, track-mounted type.
 - b. Screw terminals will not be allowed.
 - c. A terminal for each conductor of external circuits plus one ground for each shielded cable.
 - d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the panel base for conduit and wiring space.
 - e. Not less than 25 PCT spare terminals shall be provided.
 - f. Terminals shall be labeled to agree with identification indicated on the suppliers submittal drawings.
 - g. Individually fuse each control loop or system and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.
 - a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.
 - a. Markings or color code shall match the manufacturer's drawings.
7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.

C. Nameplates:

1. All devices mounted on the face of the drive shall be provided with a suitable nameplate as specified in Specification Section 16195, Identification for Electrical Systems.
2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.

3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.
- D. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.8 COMPONENTS AND ACCESSORIES

A. Reactors:

1. Impedance: 5 PCT.
2. Continuous current: Not less than drive rating.
3. Current overload: 150 PCT for 1 minute.
4. Insulation temperature rating: 180 DEGC.
5. Copper windings.
6. Saturation current rating: 3.5 to 5 times rated current.
7. Hi-potential rating: 2500 VAC line to ground and line to line, for 1 minute.
8. Noise reduction features:
 - a. Epoxy over cast coil.
 - b. Extra dips and bakes of varnish over continuous wound coil.

2.9 SOURCE QUALITY CONTROL

A. Factory Tests:

1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.

2.10 MAINTENANCE MATERIALS

- A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).
- B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

2.11 WARRANTY

- A. The manufacture shall include a warranty that extends 10-years (120 months) from date of shipment from manufacturer.
- B. The warranty shall be DRIVE PRO-TECTION ONSITE or equivalent and shall cover:

1. Product defect and normal-wear.
 2. Line anomalies including lightning strikes.
 3. Load anomalies.
 4. Accidental exposure to moisture or corrosives.
 5. Accidental collision or other physical damage
- C. Manufacturer will be responsible for all travel costs to repair equipment onsite.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.
- B. Provide separately mounted VFD enclosure with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
1. Determine the SCCR rating by one of the following methods:
 - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - b. Method 2: SCCR rating meets or exceeds the equipment's Amp Interrupting source Current (AIC) rating as indicated on the Drawings.
 - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
 3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.
- C. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.
- D. Provide services of manufacturer's representative to perform start-up services.
- E. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.
1. The space available on the Drawings shall not be exceeded.

3.2 START UP

A. Pre-start-up Services:

1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period described in Specification Section 01650.
2. Shall consist of:
 - a. Physical and electrical installation check.
 - b. Final adjustments and calibration of drive parameters.
 - c. VFD operation from simulated input signals.
3. Shall be complete when VFD(s) are fully operational.

B. Field Quality Control:

1. Perform field measurement of harmonics at each PCC per Harmonic Protection Requirements Article.
 - a. For each individual VFD.
 - b. For the maximum number of VFDs that will be operational at the same time.
 - c. When all loads are at 75 PCT load minimum.
 - d. Duration: 1 HR minimum.
2. Perform field measurement of the maximum voltage peak at the terminals of each motor fed from a VFD per Motor Protection Requirements Article.
 - a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
 - i). Time shall be measured in microseconds.
 - b. Tests shall be performed at full:
 - i). Full voltage and speed.
 - ii). Loaded to 75 PCT minimum.
 - iii). Duration: 1 HR minimum.

3. Record all data necessary for the preparation of required test reports.

C. Start-up and Demonstration Services:

1. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
 - a. Perform all work in the presence of the Owner's designated representatives.
2. Setup all VFDs with carrier frequency at minimum value consistent with proper operation; inform Engineer of carrier frequencies set in excess of 5

kHz and reason for setting.

3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
 - a. Ensure compatibility of VFD with associated control and instrumentation signals.
 4. Simulate VFD failures and demonstrate troubleshooting aids.
 5. Setup remote monitoring.
- D. Instruct Owner's designated personnel:
1. Minimum of 8 HRS at the jobsite.
 2. Include both field and classroom instruction.
 3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
 - a. Lubrication.
 - b. Troubleshooting.
 - c. Repair and replacement.
 - d. Parts inventory.
 - e. Maintenance records.

END OF SECTION

SECTION 16520
EXTERIOR LUMINAIRES

PART 1 GENERAL

1.1 SCOPE

This Section includes exterior lighting fixtures lamps, ballasts and accessories. Fixtures include lamps and parts required to distribute the light, position and protect lamps and connect lamps to the power supply. Exterior luminaires specified to be installed under this section should be erected, and placed in proper operating condition in full conformity with electrical drawings unless electrical engineer notes exceptions. Illumination levels: Per Illumination Engineering Society of North America Handbook recommendations.

1.2 SECTION INCLUDES

Luminaires, poles and accessories.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate dimensions and components for each luminaire not standard Product of manufacturer.
- B. Product Data: Submit dimensions, ratings, and performance data.

1.4 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 RELATED SECTIONS

- A. Section 16100 – Basic Materials and Methods
- B. Section 16123 – Building Wire and Cable
- C. Section 16140 – Wiring Devices
- D. Section 16450 – Grounding

1.6 DELIVERY, STORAGE, AND HANDLING

Store and handle solid wood poles in accordance with ANSI O5.1.

1.7 COORDINATION

Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.8 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 3. ANSI O5.1 - Wood Poles, Specifications and Dimensions.
- B. National Fire Protection Association: NFPA 70 - National Electrical Code.
- C. Illumination Engineering Society of North America: Handbook.

1.9 WARRANTY

Contractor shall warrantee the work in accordance with the General Conditions.

PART 2 PRODUCTS

2.1 LUMINAIRES

Product Description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.

2.2 LIGHT EMITTING DIODE (LED)

Manufacturers:

- A. Holophane
- B. Lithonia Lighting
- C. American Electric Lighting
- D. LHXC
- E. XTRALITE
- F. PL&T
- G. Or Approved Equal.

PART 3 EXECUTION

3.1 EXAMINATION

Verify foundations are ready to receive fixtures.

3.2 EXISTING WORK

- A. Disconnect and remove abandoned exterior luminaires.
- B. Extend existing exterior luminaire installations using materials and methods compatible with existing installations, or as specified.
- C. Clean and repair existing exterior luminaires to remain or to be reinstalled.

3.3 ADJUSTING

Aim and adjust luminaires to provide illumination levels and distribution.

3.4 CLEANING

- A. Clean photometric control surfaces as recommended by manufacturer.
- B. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK

Relamp luminaires having failed lamps at Substantial Completion.

+++ END OF SECTION +++

SECTION 16960

CONTROL CIRCUITS AND PILOT DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes furnishing, unless otherwise indicated, and installing all materials and providing all labor and supervision pertaining to control circuits and pilot devices.
- B. Unless otherwise indicated, all pilot devices, such as pushbutton stations, selector switches, thermostats, firestats, smoke switches, pressure switches, limit switches, float switches, flow switches, pneumatic-electric switches, recorder controllers, and the like, shall be furnished by the supplier of each item or group of items of driven equipment specified in other Divisions of these specifications. The Contractor shall refer to the appropriate Divisions under which driven equipment, or control system applicable thereto, is to be furnished for all specific requirements which may have a bearing on work under this Section, and shall provide the proper services and other electrical work required to make the equipment operable.
- C. In general, all "line" voltage (120 volts and higher) control wiring shall be provided under this Section and lower voltage wiring, such as for low voltage temperature control systems and the like, shall be furnished under the requirements of other Sections.

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

Catalog cuts, electrical ratings, adjustment ranges, enclosure types and dimensions, necessary internal and interconnection diagrams, etc.

1.3 QUALITY CRITERIA

Control devices shall comply with U.L., NEMA, and N.E.C. requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pilot devices shall generally be heavy-duty industrial type with adequately rated precious metal contacts. Enclosures shall be as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings.
- B. Specific requirements for pilot devices to be provided under this Division shall be as indicated on the drawings or as called for under other Sections of this Division.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pilot devices and wiring thereto shall be properly supported.
- B. Control circuits shall be provided and connected in accordance with diagrams indicated on the drawings and/or in accordance with diagrams to be furnished by the supplier of the driven equipment or by the supplier of the control system involved therewith.
- C. All required device adjustments and settings and all required re-connections shall be provided to make all systems and equipment operate in a satisfactory manner.

END OF SECTION

SECTION 16999

ACCEPTANCE TESTING AND CALIBRATION

PART 1 - GENERAL

1.1 SCOPE

This Section includes the field testing, inspection and adjusting of all material and equipment installed. Other Electrical Sections covering individual types of equipment may have additional testing requirements.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. NEC, National Electrical Code.
 - 2. NEMA, National Electrical Manufacturers Association
 - 3. ASTM, American Society for Testing Materials.
 - 4. IEEE, Institute of Electrical and Electronics Engineers.
 - 5. NETA, National Electrical Testing Association.
 - 6. ANSI, American National Standards Institute.
 - 7. IPCEA, Insulated Power Cable Engineers Association.
 - 8. OSHA, Occupational Safety and Health Act.
- B. Items not passing test will be rejected and shall be repaired or replaced with acceptable new items. The repaired and replacement items shall be tested.

PART 2 - PRODUCTS Not Applicable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Inspect, test and calibrate in accord with manufacturer's instructions supplemented by this Specification.
- B. Institute and maintain rigorous precautions for all test procedures. Maintain telephone or voice radio contact between the potential source location and energized remote locations during any potential testing operations.
- C. Contractor shall utilize the services of a testing firm, approved by the Engineer, which is regularly engaged in the testing of electrical equipment, devices, installations and systems to conduct all of the testing

specified in this Section. The testing firm shall meet the qualification criteria set forth in NETA acceptance testing specification.

3.2 POWER CIRCUIT BREAKERS

- A. Preparatory Work: Prior to testing, remove each breaker from its compartment. Clean, lubricate, inspect and adjust each breaker in accord with manufacturer's published maintenance instructions. Inspect contacts, arc quenchers, primary and secondary disconnects, current sensors, small wiring and trip devices. Examine contacts for condition, clearance, pressure and wipe.
- B. Tests and Data: Determine and record the following data:
 - 1. Breaker identification, including City's designation, manufacturer's ratings, serial number, trip device type, ranges and time bands.
 - 2. Test each breaker electrically for proper tripping characteristics by passing 60 Hz. sinusoidal low voltage current through each pole, one at a time, with test current injection at the primary disconnects. Adjust trip devices for required pickup characteristics. Perform tests at operating trip device settings as specified. Include this information in the report plus the record of the settings "as left" after calibration.
 - 3. Apply sufficient current to actuate each mode of trip device, i.e., long time pickup, long time delay band, short time pickup, short time delay band, instantaneous pickup, ground pickup and ground delay band as applicable. Test current and elapsed time at tripping. For each pole, state whether or not breaker tripping is within the manufacturer's tolerances.
 - 4. Perform insulation resistance test on each breaker. With contacts closed, apply 1000 volts DC for each 600 V and under and 250 V DC up to 5 KV and make readings after one minute energization between each pair of poles and from each pole to the breaker frame.
- C. Molded Case Circuit Breakers and Motor Circuit Protectors. Test automatic molded case circuit breakers for acceptance. Quantity to be tested is indicated below.
 - 1. Thermomagnetic Trips. (Breakers Only). Test breakers having thermomagnetic trips in a temperature controlled environment maintained at 40° C plus or minus 30° C. A temperature stabilization period of 15 minutes is required prior to testing the inverse-time automatic tripping characteristics. Test each pole of each breaker at 90% and 200% of its continuous current rating. Replace any breaker or trip device which trips within 10 minutes at 90%, or which fails to trip at 200% within the time indicated in the following table:

Rated Continuous Current, Amperes	Max. Tripping Time, Minutes	Breakers tested per Panel or Switchboard
15 - 40	2	10% (not less than 2)
50	4	20% (not less than 1)
60 - 100	6	50% (not less than 1)
125 - 225	8	100%
250 - 400	10	100%
500 - 600	12	100%
700 - 800	14	100%
1000	16	100%
1200	18	100%

2. Instantaneous Trips. Test each pole of each breaker and motor circuit protector for automatic instantaneous tripping with slowly rising current. Replace any breaker or trip device which fails to operate within the following values:
Non Adjustable Trips - plus or minus 20% of fixed setting.
Adjustable Trips - plus or minus 10% of the high setting of the rms values of the instantaneous tripping current.
3. Motor Circuit Protectors after testing shall be placed in service at the minimum position which permits motor starting based on motor nameplate data following MCP manufacturer's instructions.

3.3 MOTORS AND MOTOR CONTROLS

- A. Inspect and test motors and motor wiring, power and control for proper connection, circuit continuity, wire identification, insulation resistance and proper functioning or operation. Test insulation resistance from line to line and from each line to ground with a test instrument. Make tests prior to energizing circuits. Test motors for correct rotation. Test proper operation of starters and control devices. Record the nameplate data of motors for the selection of the proper overload relay heater size.
- B. Test and inspect power distribution equipment for damage, defects and for proper functioning of all electrical and mechanical components. Test line and load bus, connections and conductors and test circuit breakers for proper electrical and mechanical operation.
- C. Place motor circuit protectors in service at the minimum position which permits motor starting, based on motor nameplate data and following MCP manufacturer's instructions.

3.4 SPECIAL SYSTEMS

Exercise care in the testing of electrical systems so as not to damage special, electronic or instrumented circuits. Do not undertake to check or test special electronic or instrumented circuits beyond the manufacturer's instructions included with the equipment and performed for equipment installation. Test the continuity only for alarm, instrumentation, or similar special wiring systems prior to the final equipment connections.

3.5 INSULATION TESTS

- A. Furnish the necessary test equipment and labor to test the insulation of electrical equipment and circuits before they are energized. Use a 1000 volt "Megger" or other approved instrument, to test the insulation resistance of circuits insulated for 600 volts, associated motors and transformers, low-voltage motor control centers and low voltage switchboard.
- B. Insulation Tests: Include, but are not limited to, the following:
1. Transformers: Test primary to ground, secondary to ground and primary to secondary.
 2. Services: Test phase to phase and each phase to ground.
 3. Cables: Test phase to phase and each phase to ground.
 4. Perform continuity test to ensure proper cable connection.
 5. Motors: Test winding to ground.
 6. Load Side of 600 Volt Circuits: Test each phase to ground and phase to phase.
 7. Minimum Acceptable Megger Readings (Megohms at 20 C) for 600 volt class equipment:

Transformers	Megohms
Primary to ground	20
Primary to Secondary	20
Secondary to Ground	5
Services - Motor Starters and Buses	20
Motors	1
Load side of 600 volt circuits less motor	20

- C. Control power transformers, potential transformers and other devices connected phase to phase or phase to ground and any devices not designed to withstand the test voltages must be disconnected when testing insulation resistance in switchboard, motor control centers and other apparatus.
- D. Keep written record of tests performed on forms approved for the purpose and turned over to Engineer upon request, or at the termination of the

Work. Identify each circuit or piece of apparatus tested, the date of the test, the temperature at the time of testing, the instrument used, the test voltage applied, the resistance values found and the name of the person in charge of and witnessing the test.

3.6 FINAL INSPECTION AND TEST

- A. Upon completion of the various phases of the project, or at convenient times during progress of the Work, check and/or test as herein specified all equipment and wire installed.
- B. Upon receipt of written notice that the work has been completed, including tests herein specified, Engineer's representative will give the entire work a thorough inspection. Any defects or omissions noted shall be corrected before acceptance of the work.
- C. The inspections and tests to be made by the Contractor shall include, but are not limited to, the following:
 - 1. Visually inspect wires and cable connections including internal wiring of switchgear, transformers and other equipment.
 - 2. Verify continuity of power and control conductors.
 - 3. Make insulation tests as herein specified.
 - 4. Check control circuits for short circuits and extraneous grounds.
 - 5. Check equipment for proper mechanical adjustment and freedom of operation and removal of shipping blocks and/or stops.
 - 6. Check closing, tripping, supervision and alarm functions of the controlled equipment.
 - 7. Operate motor controllers, contactors, etc., from their control devices.
 - 8. Check operation of alarm circuits.
 - 9. Check motors for proper rotation and motor currents measured under load conditions. Any motor found to be operating incorrectly shall be inspected to determine the cause and the condition shall be corrected to the satisfaction of Engineer. Furnish a record of these tests to Engineer.

END OF SECTION

SECTION 17000

INSTRUMENTATION, CONTROL AND MONITORING SYSTEM GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. The Instrumentation, Control, and Monitoring (ICM) System scope of work consists of new instruments, demolition of existing control panels, new Allen Bradley CompactLogix PLC based control panel (LCP-100) with 15" Panelview, a Remote Control Panel (RCP-100), fiber optic cable, field components, and updating the existing HMI Screens at the Clear Creek Pump Station (Inductive Automation) and South River Water Reclamation Facility (Invensys Foxboro) including the historian, alarms, and all other existing pump station functions. The Contractor shall procure the services of a single ICM System Supplier (Supplier) to furnish and install all materials, equipment, labor and services, except for those services and materials specifically noted, required to achieve a fully integrated and operational ICM System at the Flint River Pump Station as specified herein and in other Specification Sections listed below.
- B. This Section covers the general requirements for furnishing and installing the ICM system complete in every detail for the purposes specified and shall form a part of all other Sections of Division 17 unless otherwise specified. Other Sections of this Division shall supplement this Section as necessary.

1. Work Included

Furnish all tools, equipment, materials, and supplies and perform all labor required to complete the furnishing and installation of, validation, start up and operational testing of a complete and operable Instrumentation, Control and Monitoring System as indicated on the Drawings and as specified herein.

Provide all the necessary equipment components, interconnections and the services of the manufacturers' engineering representatives for the engineering, implementation, startup, operation, and instruction, to ensure that the City receives a completely integrated and operational ICM as herein specified.

2. Work Not Included

Process piping, installation of in line instrumentation, i.e., final control elements in process pipelines, air compressors, main air supply headers, and miscellaneous mechanical work as specified in other Divisions.

Electrical power distribution and signal wiring specifically included under Division 16, circuit protection devices, power conduit and wiring indicated, local equipment control stations, and miscellaneous electrical requirements as specified in Division 16.

C. System Responsibility

1. Each Section in this Division shall be provided by a competent, qualified Supplier. System installation, including calibration, validation, start up, operational testing, and training shall be performed by qualified personnel, possessing all the necessary equipment and experience. The System shall be integrated using the latest, most modern proven technology.
2. The Contractor may subcontract the work under this Division to qualified Suppliers, but this shall not relieve the Contractor from any responsibility under the Contract.
3. The Contractor shall be responsible for the correct installation of all hardware and systems specified in this Division and shall assure system uniformity, subsystem compatibility and coordination of all system interfaces, submittals, documentation, testing and training.
4. The Contractor shall determine that all components of each section are completely compatible with other required equipment, and shall function as outlined, and the Contractor shall furnish and install such additional equipment, accessories, etc. as are necessary to meet these objectives at no additional cost to the City.

D. Contract Drawings

Information on the Drawings

The following information relative to the work of this Division is indicated on the Contract Drawings.

1. Location of all primary elements, cabinets, and final control elements.
2. Instrumentation signal and power conduit runs between control panels and field instruments and devices.
3. Quantity and sizes of instrumentation conductors and cables are indicated on the drawings, but shall be verified by the Contractor.
4. Major instrument conduit runs.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Supplier:

- a. Shall be financially sound with at least five years continuous experience in designing, implementing, supplying, and supporting instrumentation and control systems for municipal wastewater treatment facilities comparable to the instrumentation and control systems required for the project, relative to hardware, software, cost, and complexity.
 - b. Shall have record of successful instrumentation and control system equipment installations, including Allen Bradley and Foxboro DCS hardware installation and software configuration. Upon engineer's request, submit record of experience listing for each project: project name, owner name and contact information, name and contact information for contractor, name and contact information for engineer or architect, approximate contract value of instrumentation and controls work for which supplier was responsible,
 - c. Shall have at time of bid experienced engineering and technical staff capable of designing, supplying, implementing, and supporting the instrument and control system and complying with submittal and training requirements of the contract documents.
 - d. Shall be capable of training operations and maintenance personnel in instrumentation and control applications, and in operating, programming, and maintaining the control system and equipment.
 - e. Shall have UL-approved panel shop.
 - f. Shall be Global Controls, MR Systems, C2I, Southern Flow or approved equal.
2. Manufacturer: manufacturers of instrumentation and control equipment furnished under this section shall be experienced producing similar equipment and shall have the following qualifications:
- a. Shall manufacture instrumentation and control system components that are fully-developed, field-proven, and of standardized designs.
 - b. Shall have system of traceability of manufactured unit through production and testing in accordance with ANSI/ASQ Z1.4.
 - c. Shall have guaranteed availability clause (99.99 percent, minimum for one year) for microprocessor-based components and appurtenances.
 - d. Shall have documented product safety policy relevant to products proposed for the work.

- B. The Contractor may subcontract the work under this Division to qualified Suppliers, but this shall not relieve the Contractor from any responsibility under the Contract.
- C. The Contractor shall be responsible for the correct installation of all hardware and systems specified in this Division and shall assure system uniformity, subsystem compatibility and coordination of all system interfaces, submittals, documentation, testing and training.

1.3 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- B. GENERAL

- 1. Presubmittal Conference

Arrange a conference between the Supplier of each Section, Contractor, and the Engineer within thirty (30) days after award of the Contract for the purpose of informally discussing in detail and verifying the correctness of the Contractor's system engineering methods and equipment and to generally provide a framework for communication and coordination. This conference shall be attended by the Supplier's Engineer, and duly authorized representatives of the Contractor and the Engineer.

- 2. Draft Submittal

Prepare a draft of the submittal for review. The draft shall include the following, as a minimum:

- a. Listing of major items proposed for this Division. Identify items by tag number, description, function, manufacturer, model number, descriptive literature and statement as to whether item is "as specified" or "equivalent." Items identified as "equivalent" shall be accompanied by a comparative listing of the published specifications for the item specified and for the item proposed. Equivalent items shall only be accepted by the City if the specified item is no longer manufactured.
 - b. Shop Drawings. Before proceeding with any manufacturing, submit Shop Drawings for approval in complete bound sets indexed by specification number. Describe the items being submitted. Manufacturer's specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Submit only

complete systems, not pieces of equipment from various systems. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Schematics shall be complete with tag and terminal numbers. Submit fabrication drawings, nameplate legends, and control panel internal wiring and piping schematic drawings clearly showing all equipment and tag numbers on all panels. Include material specifications lists where applicable. Submit detailed field instrument installation drawings for each instrument.

C. Design Related Submittals

Provide five (5) copies of the following submittals:

1. Catalog Cuts

Catalog information, descriptive literature, wiring diagrams, and shop drawings shall be provided for all devices, whether electrical or mechanical, furnished under this section. This includes, but is not limited to, primary elements, transmitters, analytical equipment, gauges, valves, controllers, indicators, power supplies, switches, lights, relays, timers, etc.

2. Component Data Sheets

Data sheets, specification sheets, and an instrument list shall be provided for all components provided under this section. The purpose of this material is to supplement the generalized catalog information by providing the specifics of each component (e.g., complete part numbers, scales, ranges, service, materials of construction, component location, options, and the individual tag number as noted in the Drawings and Specifications.

Include such other necessary data as would provide a complete and adequate specification for reordering an exact duplicate of the original item from the manufacturer at some future date. More than one tag numbered item may be included on a sheet.

3. Sizing Calculations

Complete sizing calculations shall be provided for all flow elements. The calculations shall include the process data used, minimum and maximum values, permanent head loss and all assumptions made. Equations shall be submitted for all differential pressure flow elements and shall include the actual scaling factors and units used.

4. Panel Construction Drawings

Shop Drawings and Catalog Cuts

Provide detailed shop drawings and catalog cuts for all panels, instrument racks, and enclosures. Drawings shall show the location of all front panel and internal sub-panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show all major dimensions as well as elevations, in inches from the base up, of all rows of components.

The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends, and annunciator inscriptions.

The bill of materials shall include all devices including those mounted within the panel that are not listed in the panel legend, and shall include the device tag number, description, manufacturer, and complete model number.

5. Panel Wiring Diagrams

Wiring diagrams shall be similar to those diagrams shown in the Contract Drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, etc.

Provide complete terminal identification of all external primary elements, panels, and junction boxes that interface directly to the panel wiring being shown. Polarity of analog signals shall be shown at each terminal.

All external wiring that the electrical contractor must provide and wire shall be shown as a dotted line. Special cables that are provided with the instrument shall be clearly identified.

Panel wiring diagrams shall identify wire numbers and types, terminal numbers, and tag numbers. Wiring diagrams shall show all circuits individually; no common diagrams shall be allowed.

Provide panel power wiring diagrams for all panels. The diagrams shall include all grounding requirements.

6. Interconnecting Wiring Diagrams

Diagrams shall show all component and Termination Cabinet identification numbers and external wire, fiber, and cable numbers. This diagram shall be coordinated with the Electrical Supplier and shall bear his mark showing that this has been done.

7. Loop Diagrams

Provide an individual wiring diagram for each analog loop showing all terminal numbers, the location of the DC power supply, signal polarity, the location of any dropping resistors, surge protection, shielding, grounding, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus the following requirements:

Each loop diagram shall be divided into areas for identification of device locations (e.g. panel face, back of panel, field, etc.). Each loop diagram shall list (1) Transmitter Drive Capability, (2) Loop Impedance, (3) Transmitter Reserve Drive Capability. Loop diagrams shall be on 11 inches by 17 inches Drawings.

8. Instrument Installation Details

The ICM Supplier shall review the Contract Documents and develop and submit for review, complete installation details for each field mounted device and panel prior to shipment and installation. Common details, not requiring any modification, may be referenced by an index showing the complete instrument tag number, service, location, and device description. Installation details shall be provided as required to adequately define the installation of the ICM components.

D. Test Related Submittals

Provide five (5) copies of the following:

1. Factory Acceptance Test Procedure:

Submit factory testing procedures that will be performed to fulfill requirements of the Contract Documents. Test procedure shall include the following:

- a. Visual inspection of components and assembly.
- b. Description of hardware operational testing.
- c. Description of software demonstration.
- d. Description of testing equipment to be used.
- e. Sign-off sheets to be used at time of testing.

2. Operational Field Acceptance Test Documentation

The ICM Supplier shall submit an example of each type of Instrument Calibration Sheet and Loop Status Report that will be used for the OAT.

After approval of the examples, the ICM Supplier shall prepare Loop Status Report Sheet(s) for each loop and an Instrument Calibration Sheet for each active I & C element (except simple hand switches, lights, etc). These sheets shall be submitted after the tests are completed.

Instrument Calibration Sheets require the ICM Supplier to provide a written report to the Engineer on each instrument certifying that it has been calibrated to its published specified accuracy. This report shall include all applicable data as listed below plus any defects noted, correction action required, and correction made. Data shall be recorded on prepared forms and shall include not less than the following items:

- a. Facility identification (Name, location, etc.)
- b. Loop identification (Name or function)
- c. Equipment tag and serial numbers.
- d. Scale Ranges and units.
- e. Test mode or type of test.
- f. Input values or settings.
- g. Expected outputs and tolerances
- h. Actual readings at 10, 50, and 90 percent of span.
- i. Explanations or special notes as applicable.
- j. Date, time, and weather.
- k. Tester's certification with name and signature.

3. Functional Acceptance Test Documentation

The ICM Supplier shall prepare two types of test procedures and forms as follows.

- a. Loop Test Documentation
For functions that can be demonstrated on a loop-by loop basis, the form shall include:
 - 1) Project Name
 - 2) Loop number
 - 3) Loop description
 - 4) Test procedure description, with a space after each specific test to facilitate sign off on completion of each test.
 - 5) For each component: tag number, description, manufacturer, and data sheet number.
 - 6) Space for sign off and date by the Contractor, the ICM Supplier, and the Engineer.
- b. Functional Test Documentation

For those functions that cannot be demonstrated on a loop by loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:

- 1) Specification page and paragraph of function demonstrated

- 2) Description of Function
- 3) Test procedure description
- 4) Space after each specific test to facilitate signoff on completion of each test.

1.4 TESTING

A. Factory Testing

1. Unwitnessed Factory Testing

Prior to the arrival of the Engineer, each panel shall have been completely tested by the manufacturers personnel. Provide report certifying the control panels are operable and meet the Specifications. If upon arrival of the Engineer, the panel(s) tests have not been performed, the Contractor may be liable for back charges for any extra time required by the Engineers services. The necessary panel tests shall be repeated in the presence of the Engineer; the Engineer, shall have the right to check all test observations. The ICM Supplier shall demonstrate, on a spot check basis, that the results of the unwitnessed Factory Tests are accurate. As a minimum, tests shall verify the following:

- a. Location of interface wires on terminal blocks.
- b. Function of discrete panel components

2. Witnessed Factory Testing

- a. Inspection and test of materials and equipment may be made by the Engineer (or his representative) at the place of manufacturer prior to shipment, to verify that the completed control panel(s) meets the requirements of the specifications. Shipment shall not be made until receipt of written approval from the Engineer after satisfactory completion of shop tests.
- b. The manufacturer furnishing materials, equipment and labor for the fabrication of the panel(s) shall afford the necessary facilities for such shop inspection and tests. The Contractor shall give the Engineer written notice three (3) weeks prior to the estimated date when the equipment will be ready for the inspection and witnessed shop test.
- c. Sufficient time, ample space and necessary assistance shall be provided by the manufacturer to assure inspection and testing to the satisfaction of the Engineer.
- d. The ICM Supplier shall furnish all power, labor, materials, and properly calibrated instruments required for the shop tests.
- e. The Engineer reserves the right to reject defective materials, poor workmanship and items that do not function in accordance with the requirements of the specifications.

- f. The ICM Supplier shall maintain approved copies of all design and testing related submittals at the site of testing for reference.

B. Operational Field Acceptance Testing

1. Installation Supervision

Furnish the services of authorized factory personnel specially trained and experienced in the installation of the equipment to: (1) supervise the installation in accordance with the approved Instruction Manual; (2) be present when the instruments and equipment are first put into operation; (3) inspect, check, adjust as necessary, and approve the installation; (4) calibrate the instruments, in accordance with the Specifications herein, until all trouble or defects are corrected and the installation and operation are acceptable.

2. Instrument Calibration

- a. Provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration. Each instrument shall be calibrated at 10 percent, 50 percent and 90 percent of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 10 times greater than the specified accuracy of the instrument being calibrated.
- b. Provide a list and basic specifications for instruments used for calibration.
- c. Submit instrument calibration data sheet at the end of the startup. The submittal shall include all instruments furnished and installed under this contract. the data sheet shall contain instrument tag number, manufacturer part name, model number, range, scale, setpoints and date of calibration.

3. System Validation

- a. Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance. System tolerance is defined as the root mean square sum of the system component published specified accuracies from input to output.
- b. Validate each system by simulating inputs at the first element in loop (i.e. sensor) of 10 percent, 50 percent and 90 percent of span, or on/off and verifying other loop devices. During system validation, make provisional

settings on levels, alarms, etc. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point. Verify that all logic sequences operate in accordance with the specifications.

- c. Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation. Test equipment for this function shall be as specified under "Instrument Calibration."
- d. Immediately correct all defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.
- e. Provide a report certifying completion of validation of each instrument system. This report shall indicate calculated system tolerances, data verifying that the system meets these tolerances, and any provisional settings made to devices. Data sheets shall be similar to those used for calibration.

4. Contractor's Certified Reports

Upon completion of all testing, the Contractor, or his authorized representative, shall submit a certified report for each control panel and associated field instruments certifying that the equipment (1) had been properly installed under his supervision, (2) is in accurate calibration, (3) was placed in operation in his presence, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactorily, and (6) is fully covered under the terms of the guarantee.

C. Functional Acceptance Testing

- 1. Upon completion of instrument calibration and system validation, test all systems under actual process conditions in the presence of the Engineer. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems. This testing shall include, but not be limited to, all specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and/or mechanical equipment.
- 2. Testing shall be observed by the Engineer. Notify the Engineer in writing a minimum of 14 days prior to the proposed date for commencing the test. Upon completion of this test the Contractor shall begin or have begun system start up. Engineer reserves the right to set the schedule.
- 3. Submit for approval not later than 30 days prior to the functional acceptance test demonstration, a written plan for demonstrating

that each system of equipment provided under Division 13 meets the specified operational requirements.

4. The plan shall detail procedures to be used in functional acceptance testing of all systems. The plan shall include a description of test methods and materials utilized for testing each system.
5. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat the testing.
6. Submit three copies of test results and records for all functional acceptance tests.
7. Upon completion of functional acceptance testing, submit certified report, with substantiating data sheets, indicating that total ICM System meets all the functional requirements specified herein. The Engineer will countersign this report and it shall constitute final acceptance of the ICM System.

D. System Commissioning Assistance

Provide the services of a factory trained and field experienced instrumentation engineer to assist City's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

E. Final Acceptance

Approved completion of the following shall constitute Final Acceptance of the ICM System.

1. Certified Functional testing Report countersigned by the Engineer.
2. Final Documentation.
3. Spares and expendables delivery.
4. Training.

1.5 OPERATION & MAINTENANCE MANUALS

- A. Furnish six (6) sets of Instruction Manuals and Part Lists for instrumentation equipment provided under Division 13. Obtain distribution method instructions from the Engineer.

B. Schedule

Deliver two (2) copies of manuals not later than the equipment shipment date. After installation is complete, update the manuals to reflect any changes which occurred during installation and deliver balance of manuals to Engineer.

C. Material Content

Include in the manuals not less than the following applicable information for each instrument, equipment, subsystem and/or control loop. The O&M Manuals shall consist of, at least, the following material:

1. Bill of Materials

A listing of all the panels, racks, instruments, components, and devices supplied. The list may be similar to the Instrument List in the Supplements. All components shall be grouped by component type, with the component types identified in a similar manner to the component identification code used in these specifications. The list shall contain, as a minimum:

- a. Instrument, panel, rack or device tag number
- b. Description
- c. Quantity supplied
- d. Reference to component data sheet and/or catalog cut
- e. Component type

2. Component Data Sheets

See 1.2 B.2 specified herein before.

3. Catalog Cuts

See 102 B.1 specified herein before.

4. Component O&M Manuals

An O&M manual shall be submitted for all instruments and devices supplied. The O&M manuals shall contain, as a minimum:

- a. Operating procedures
- b. Installation procedures
- c. Maintenance procedures
- d. Troubleshooting procedures
- e. Calibration procedures
- f. Internal device schematics and wiring diagrams
- g. Shut down procedures
- h. Component parts list

Detailed circuit operational description including programmable controller ladder diagrams.

5. Spare Parts and Expendables List

The spare parts and expendables list shall include not only those items supplied, but also the additional items recommended for successful long term operation.

6. "As Shipped" Drawings

Drawings shall be a record of work "As Shipped" from the factory and shall be labeled as "As Shipped". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder. Provide the following "As Shipped" drawings as a minimum:

- a. Panel Fabrication Drawings.
- b. Panel Wiring, Loop, and Interconnection Drawings.

1.6 FINAL "AS INSTALLED" DOCUMENTATION

A. Reproducible Drawings

1. Contractor shall submit one (1) set of reproducibles of complete schematics, wiring diagrams and installation drawings to include all installed field and panel instruments, mounting details, point to point diagrams with a cable, wire, and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled as "AS INSTALLED". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.

2. Loop Diagrams

See 1.2 C.7 specified herein before.

3. Panel Fabrication and Wiring diagrams

See 1.2 C.4 and 1.02 C.5 specified herein before.

4. Interconnecting Wiring Diagrams

See 1.2 C.6 specified herein before.

5. Instrument Installation Details

See 1.2 C.8 herein before.

B. Process and Instrumentation Diagrams

The Engineer will supply the ICM Supplier with one set of the P&ID's for revisions to reflect the final installed system to be updated by the ICM Supplier. The ICM Supplier may use these drawings for producing the final documentation.

C. Software Documentation

In addition to the reproducible hard copy of drawings and literature generated specifically for the project, one (1) USB shall be submitted to the Engineer with a copy of all custom files specifically created to generate the drawings, data sheets, bill of materials, operating procedures etc using computer assisted drawing (CAD). Drawing format shall be "AutoCAD Release 2020". USB stick shall be clearly identified by the following:

1. Project Name
2. Volume Number
3. Software Program Name and Version used to generate the files.
4. Labeled "AS INSTALLED"

1.7 TRAINING REQUIREMENTS

A. General

Provide the services of a factory trained and field experienced instrumentation engineer to conduct group training of City's designated personnel in the operation of each instrument system. Obtain Engineer's written consent that the training has been adequate. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the P & ID's, panel wiring diagrams and layouts, and the operation and maintenance manuals furnished under these Specifications.

B. Maintenance Training

Maintenance training shall include instruction in the calibration, maintenance, and repair required for all instruments. Manufacturer trained instruction shall be given for the following:

1. Flow Element and Transmitter, Electromagnetic (Minimum two (2) session, each of two (2) hours between class room and in field).
2. Level Element and Transmitter, Ultrasonic. (Minimum two (2) session, each of two (2) hours between class room and in field).

1.8 POST CONTRACT SYSTEM SUPPORT

Maintenance Contract

A. Duration

Provide a 1 year maintenance contract for all components furnished. The start date of one year maintenance support contract shall not begin before the final acceptance of the system.

B. Schedule

Develop a program of preventive maintenance visits that includes verification of instrument performance on a monthly basis and complete calibration of instruments on a semi-annual basis. After every visit, submit to the Engineer records of instrument verification and calibration on appropriate forms.

1.9 GUARANTEE AND WARRANTIES

Guarantee all work of Division 13 in accordance with the Conditions of Contract and Division 1. With respect to instruments and equipments, guarantee shall cover (a) faulty or inadequate design; (b) improper assembly or erection; (c) defective workmanship or materials; and (d) leakage, breakage, or other failure not caused by City misuse. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to Engineer with City named as beneficiary.

PART 2 - PRODUCTS

2.1 HARDWARE REQUIREMENTS

A. Job Conditions

Drawings are diagrammatic and show the intended arrangement for system operation, piping, and appurtenances. Conform to Drawings as closely as possible and exercise care (1) to secure neat arrangement of piping, valves, conduit, and like items, and (2) to overcome structural interferences. Verify dimensions and conditions at the place of work, and install materials and equipment in the available spaces.

B. Materials and Standard Specifications

Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as International Society of Automation (ISA). The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the facilities; i.e., all instruments in the plant, supplied by the Contractor, of the same type shall be by the same manufacturer. This allows the stocking of the minimum number of spare parts.

C. Product Delivery, Storage, and Handling

Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repair any damage as directed and approved.

D. Mountings

1. Mount and install equipment as indicated. Where not shown, mount field instruments according to best standard practice on pipe mounts, pedestal mounts, or other similar means in accordance with suppliers recommendation. Where mounted in control panels, mount according to manufacturer recommendations.
2. Equipment specified for field mounting shall be suitable for direct pipe mounting, pedestal mounting, or surface mounting. Non in line indicators and equipment with calibration adjustments or

requiring periodic inspection shall be mounted not lower than three (3) feet nor higher than five (5) feet above walkways, platforms, catwalks, etc. All such equipment shall be weather and splash proof, and corrosion resistant and electrical equipment shall be in NEMA 4X cases unless otherwise noted.

E. Instrument Identification

1. All components provided under this section, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire ISA tag number of the component. Panel mounted tags shall be plastic; field mounted tags shall be stamped stainless steel.
2. Nameplates for panels and panel mounted equipment shall be as specified under Section 13200, Panels.
3. Field mounted tags shall be 16 gauge, 304 stainless steel with 3/16 inch high characters.
4. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with standard stainless steel hose clamps and meeting the same description. In some cases where this would be impractical, use 20 gage stainless steel wire.
5. For field panels or large equipment cases use stainless steel screws, however, such permanent attachment shall not be on an ordinarily replaceable part. In all cases the tag shall be plainly visible to a standing observer and not obscure adjustment ports or impair the function of the instrument. Field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed. Nameplate shall be attached by one of the above methods.

F. Electronic Equipment

If the equipment is electronic in nature, provide solid state equipment to the greatest extent practicable. Select components of construction for their suitability and reliability. Employ adequate component derating to preclude failures because of transients and momentary overloads reasonably expected in normal operation. Where conduit connection is provided for mounting a surge/lightning suppressor directly to the instrument, the arrestor shall be so mounted.

G. Equipment Operating Conditions

1. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:
2. Power.

Electrical. 110 Vac +/- 10%, 60 Hz +/- 1 Hz except where specifically stated otherwise on the drawings or in the specifications.

3. Field Instruments:
 - a. Outdoor Areas:

Ambient Temperature: -15°C to +50°C
Ambient Relative Humidity: 5% to 100%
Weather: Rain, wind, sun and blowing sand.
Provide, as necessary, enclosures, and sunshields, etc. to assure normal operations under these conditions.
 - b. Indoor Environmentally Uncontrolled Areas:

Ambient Temperature: 15°C to +50°C
Ambient Relative Humidity: 5% to 80%
 - c. Indoor Environmentally Controlled Areas:

Ambient Temperature: 0°C to +50°C
Ambient Relative Humidity: 5% to 60%

H. Power Supplies

1. Provide electrical instruments and control devices for operation on 110 Vac, 60 Hz current.
2. Output overvoltage and overcurrent protective devices shall be provided for DC power supplies to protect instruments from damage due to power supply failure and to power supply from damage due to external failure. Power supplies shall be provided with enclosures as required for the area classifications indicated in Section 16100, Basic Materials and Methods, unless otherwise indicated on the Drawings. Power supplies shall be mounted such that dissipated heat does not adversely affect other components. Source of operating power shall be 110 Vac, 60 Hz commercial power. Units shall be mounted within the control panels.

I. Signal Isolators, Converters and Conditioners

Insure that input output signals of all instruments and control devices (whether furnished by the Contractor or not) are compatible. Analog signals between field and panels shall be 4 to 20 mA dc unless specifically approved otherwise. Granting such approval does not relieve the Contractor from the compatibility requirement above. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices behind control panels or in the field at point of application, as required for accurate signal acquisition.

J. Auxiliary Contacts by Others

Provide instruments and equipment to connect to auxiliary contacts provided by others for alarms, status of equipment, interlocking, and other functions as indicated and as specified herein.

K. Painting

Provide factory paint for all instruments and equipment except where in pipelines. Provide paint as required in Division 9 for non stainless steel structural supports, brackets, etc.

L. Electrical

1. The construction work shall include all the power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified and required and not specifically included under Division 16.
2. Wiring installations shall include cables, conductors, terminals, connectors, wire markers, conduits, conduit fittings, supports, hardware and all other required materials not specifically included in the work of other Divisions.
3. Provide the materials and complete all the required installations for equipment grounding as specified in Division 16 of these Specifications and indicated on the Electrical Drawings.
4. Incidental items not specifically included in the Contract Documents that can legitimately and reasonably be inferred to belong in the instrumentation work shall be provided and installed by the Contractor at no additional cost to the City.
5. Field Wiring. For wiring materials, refer to Division 16 and Details on the Electrical Drawings. Ring out signal wiring prior to termination. Provide wire number tags marked in indelible waterproof form of slip on type heat shrink or equal for each termination.

M. Process Connections

Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance, etc. All instrument pneumatic tubing shall be Type 316 stainless steel. Slope lines according to service to promote self draining or venting back to the process. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shut down of the process. Include drip legs and blow down valves for terminations of sense lines at the instruments when mounted such that condensation can accumulate. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished and installed under Section 15060, Piping and Appurtenances, but coordinated by this Division.

N. Electrical Transient Protection

1. All instrument and control equipment mounted outside of protective structures (field mounted equipment) or that have interconnecting lines from outside the protective structure shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Both power and signal circuits shall be protected with surge and transient protectors installed at the source and destination ends of the circuits. Protective devices used on 120V

ac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of IEEE Standard 28 1972 (ANSI C62.1 1971).

2. Surge and transient protectors shall be grounded according to Division 16, ELECTRICAL.
3. Field mounted protectors for signal circuits shall be Joslyn Model No. 1669 02, -06, or equal. Panel mounted protectors for signal circuits shall be Joslyn Model No. 1663-08, or equal. Protectors for 120 volt power circuits shall be Joslyn Model No. 1250 32 secondary arrestor, or equal.

O. Spares and Maintenance Materials

1. Furnish the following items as specified herein. Deliver to Engineer, as directed, with itemized list in a letter of transmittal accompanying each shipment.
2. Materials shall be delivered in the manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.
3. One Fuse of each size and type for every five used but no less than five of each type.
4. One Relay of each type for every five used but no less than two of each type.
5. One Panel Indicating Light Bulb for every five used but no less than four of each type.
6. One Transient Protector for every five used but no less than four of each type.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 17100

INSTRUMENTATION, CONTROL AND MONITORING SYSTEM LOOP DESCRIPTIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes the Instrumentation, Control & Monitoring system (ICM). It is the intent of this Section to also supplement where applicable, other Sections of Division 17. It is the intent of this Section to briefly describe each main system in order that the ICM Systems Supplier (Supplier), as well as suppliers of packaged systems and subsystems shall be aware of the magnitude of the total ICM System. Certain systems described are supplied as package systems furnished under other divisions or by the City and are so identified. Interfacing with these systems is a part of the work of this Division.
- B. Areas classified as Class 1, Division 1, Group D, hazardous are the influent and effluent wetwell and all other areas outlined in NFPA 820. The Contractor shall insure that all equipment and electrical circuits comply with this classification. Intrinsic safety barriers shall be furnished on all circuits that cannot be readily purchased or made to comply with requirements of Class 1, Division 1, Group D, hazardous area.

1.2 INSTRUMENTATION AND CONTROL PHILOSOPHY

The instrumentation and control equipment for the Flint River Pump Station), as described herein, is based on providing sufficient measurement, indication and/or automatic control to enable process operation within the design criteria. Automatic control loops are specified only where necessary and include manual bypass control options. Adequate monitoring equipment is specified to permit complete process operational management and evaluation and for operator protection. In general, automatic controls are confined to level, time, water quality, flow and where necessary, quality type controls. Other more sophisticated controls may be included in some packaged systems of mechanical equipment.

1.3 PROCESS INSTRUMENTATION, CONTROL & MONITORING FUNCTIONS.

- A. The overall function of the Instrumentation, Control, and Monitoring System shall be to provide an efficient control and monitoring interface between plant operations and treatment processes by presenting visual and audible information of plant operating parameters, equipment status and wear, and alarm conditions. It provides automatic control of critical parameters or parameters which would require frequent operator attention.

The system shall provide means for manual override operation of any automatic function when required and shall permit control of the operation of motors and valves that are pertinent to satisfactory process performance. Control and monitoring shall be accomplished locally or remotely by the Central Control and Monitoring System. The system shall provide the following described functions in accordance with the process and instrumentation diagrams ("I" Drawings).

- B. Included herein are functional descriptions of the process instrumentation and control systems which specify the responsibility of the Process Instrumentation, Control & Monitoring System Supplier. These descriptions are to supplement the Process and Instrumentation Drawings and neither is complete without the other. If the Supplier

requires devices other than shown on the Drawings and/or specified herein to achieve the result required by the system description, provide these devices to obtain the required result.

- C. The system descriptions herein cover all processes upgraded under this contract even though no specific ICM work is required in a given system. These descriptions are provided mainly for guidance during testing of the new equipment and instruments. The Supplier shall provide additional Distributed Control System (DCS) programing and Human Machine Interface (HMI) configuration which is so identified in this section. Some minor programing changes to the exiting control strategies that are not described in this section and/or are identify during testing and startup shall be performed by the Supplier at no additional cost to the city.

1.4 INPUT/OUTPUT LIST IDENTIFICATION

The Input Output (I/O) point lists contain the information necessary to configure the PLC I/O interface hardware and to indicate range conversion or signal functions.

1.5 FACILITY LOOP DESCRIPTIONS:

- A. Influent Grinder #1
 - 1. Drawings(s): I1-01
 - 2. Equipment:
 - a. Grinder #1 Control Panel
 - 3. Process Overview
 - a. The Run / Fault / In Auto status of the Grinder #1 Control Panel will be monitored and displayed.
 - b. Runtime and amp-draw will be monitored and displayed.
- B. Influent Wetwell
 - 1. Drawings(s): I1-01

2. Equipment:
 - a. Existing Ultrasonic Level Transmitter LIT/LE 1.1
 - b. Float Switches LSHH1.1, LSLL1.1A, LSLL1.1B
 - c. Influent Pumps 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
 - d. VFDs 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
 - e. Gas Sampling Panel
3. Process Overview
 - a. The local control panels shall include a HAND/OFF/AUTO selector switch, START/STOP pushbutton, and SPEED CONTROL potentiometer. Indicating lights shall indicate PUMP RUNNING, FAULT, and CONTROL POWER ON.
 - 1) In HAND, the pump shall be controlled manually via START/STOP pushbutton located on LCP. SPEED shall be controlled by SPEED CONTROL potentiometer on LCP.
 - 2) In OFF, the pumps shall not run.
 - 3) In AUTO, the pumps shall be controlled remotely from the central SCADA system and OIT.
 - b. Pump Sequencing:
 - 1) Pump 1.1, Pump 1.2, Pump 1.3, Pump 1.4 are all considered duty pumps and shall rotate based on which pump has not run for the longest period of time.
 - 2) Pump 1.5 and Pump 1.6 are both considered duty pumps and shall alternative.
 - c. AUTO Control Logic:
 - 1) At Elevation 925' (operator adjustable), one of Pumps 1.1-1.4 turns on and runs at full speed.
 - 2) At Elevation 926' (operator adjustable), a second of Pumps 1.1-1.4 turns on and runs at full speed.
 - 3) At Elevation 927' (operator adjustable), one of Pumps 1.5-1.6 turns on and runs at full speed.
 - 4) At Elevation 928' (operator adjustable), all Pumps Turn On and run at full speed.
 - 5) At Elevation 926' (operator adjustable), Pump 1.5 and 1.6 are turned OFF.
 - 6) At Elevation 924' (operator adjustable) – Pumps 1.1-1.4 are turned OFF.

C. Headworks Facility

1. Drawings(s): I4-01
2. Equipment:
 - a. Grinder #2 Control Panel
 - b. Existing College Park Flow Meter (Parshal Flume) LIT/LE CP
 - c. Electric Gates SG4.1, SG4.2, and SG 4.3

- d. Screenings Control Panel
- e. Existing East and West Parshall Flumes FIT 2.2 / LE 3.2A / LE 3.2B
- 3. Process Overview:
 - 1) Refer to Specification 11113 and 14620 for screening panel, control, and conveyor control requirements.
 - 2) At Elevation 958' (operator adjustable) gate SG4.3 shall fully open to allow for bypass of flow.

D. Effluent Wetwell

- 1. Drawings(s): I5-01
- 2. Equipment:
 - a. Existing Ultrasonic Level Transmitter LIT/LE 5.1
 - b. Float Switches LSHH5.1, LSLL5.1
 - c. Effluent Pumps 5.1, 5.2, 5.3, 5.4, 5.5
 - d. VFDs 5.1, 5.2, 5.3
 - e. RVSS 5.4, 5.5
 - f. Pump Pressure Indicating Devices PI 5.1, 5.2, 5.3, 5.4, 5.5
 - g. Force Main Pressure Transmitter PIT 5.0
 - h. Force Main Transit Time Flow Meter FIT-5.0
- 3. Process Overview
 - a. For Pumps 5.1-5.3, local control panels shall include a HAND/OFF/AUTO selector switch, START/STOP pushbutton, and SPEED CONTROL potentiometer. Indicating lights shall indicate PUMP RUNNING, FAULT, and CONTROL POWER ON.
 - 1) In HAND, the pump shall be controlled manually via START/STOP pushbutton located on LCP. SPEED shall be controlled by SPEED CONTROL potentiometer on LCP.
 - 2) In OFF, the pumps shall not run.
 - 3) In AUTO, the pumps shall be controlled remotely from the central SCADA system and OIT.
 - b. For Pumps 5.4-5.5, local control panels shall include a HAND/OFF/AUTO selector switch, and START/STOP pushbutton. Indicating lights shall indicate PUMP RUNNING, FAULT, and CONTROL POWER ON.
 - 1) In HAND, the pump shall be controlled manually via START/STOP pushbutton located on LCP.
 - 2) In OFF, the pumps shall not run.
 - 3) In AUTO, the pumps shall be controlled remotely from the central SCADA system and OIT.
 - c. Pump Sequencing:

- 1) Pump 5.1, Pump 5.2, Pump 5.3, are all considered duty pumps and shall rotate based which pump has not run for the longest period of time.
 - 2) Pump 5.4 and Pump 5.5 are both considered duty pumps and shall alternative.
- d. AUTO Control Logic:
- 1) Pumps 5.1-5.3 will be paced to match the flow rate of Existing East and West Parshall Flumes FIT 2.2 / LE 3.2A / LE 3.2B. When the elevation in the wet well reached 948' (operator adjustable but shall be tied to Item 3 of this section) Pumps 5.1-5.3 shall shut down.
 - 2) Pumps 5.1-5.3 shall have an OFF setpoint of 943.25' (operator adjustable).
 - 3) Pumps 5.4 and 5.5 shall have an ON setpoint of 948' (operator adjustable but shall match Item 1 of this section).
 - 4) Pumps 5.4 and 5.5 shall have an OFF setpoint of 944.5' (operator adjustable) and flow pacing described in Item 1 shall be restored.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SUPPLEMENTS

- A. The supplements listed below, following the "End of Section 17100" designation, are part of this Specification section.
- B. Input/Output List

END OF SECTION

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	SIGNAL FROM	SIGNAL TO
				DEVICE	DEVICE
PUMP STATION CONTROL PANEL (LCP-100)					
01-SI-101	INFLUENT PUMP 1 VFD1.1 SPEED FEEDBACK	I1-01	ETH	VFD 1.1	LCP-100
01-YN-101	INFLUENT PUMP 1 VFD1.1 IN REMOTE	I1-01	ETH	VFD 1.1	LCP-100
01-XA-101	INFLUENT PUMP 1 VFD1.1 FAULT	I1-01	ETH	VFD 1.1	LCP-100
01-HS-101	INFLUENT PUMP 1 VFD1.1 START/STOP	I1-01	ETH	VFD 1.1	LCP-100
01-SC-101	INFLUENT PUMP 1 VFD1.1 SPEED COMMAND	I1-01	ETH	VFD 1.1	LCP-100
01-YL-101	INFLUENT PUMP 1 VFD1.1 RUNNING	I1-01	ETH	VFD 1.1	LCP-100
01-SI-102	INFLUENT PUMP 2 VFD1.2 SPEED FEEDBACK	I1-01	ETH	VFD 1.2	LCP-100
01-YN-102	INFLUENT PUMP 2 VFD1.2 IN REMOTE	I1-01	ETH	VFD 1.2	LCP-100
01-XA-102	INFLUENT PUMP 2 VFD1.2 FAULT	I1-01	ETH	VFD 1.2	LCP-100
01-HS-102	INFLUENT PUMP 2 VFD1.2 START/STOP	I1-01	ETH	VFD 1.2	LCP-100
01-SC-102	INFLUENT PUMP 2 VFD1.2 SPEED COMMAND	I1-01	ETH	VFD 1.2	LCP-100
01-YL-102	INFLUENT PUMP 2 VFD1.2 RUNNING	I1-01	ETH	VFD 1.2	LCP-100
01-SI-103	INFLUENT PUMP 3 VFD1.3 SPEED FEEDBACK	I1-01	ETH	VFD 1.1	LCP-100
01-YN-103	INFLUENT PUMP 3 VFD1.3 IN REMOTE	I1-01	ETH	VFD 1.3	LCP-100
01-XA-103	INFLUENT PUMP 3 VFD1.3 FAULT	I1-01	ETH	VFD 1.3	LCP-100
01-HS-103	INFLUENT PUMP 3 VFD1.3 START/STOP	I1-01	ETH	VFD 1.3	LCP-100
01-SC-103	INFLUENT PUMP 3 VFD1.3 SPEED COMMAND	I1-01	ETH	VFD 1.3	LCP-100
01-YL-103	INFLUENT PUMP 3 VFD1.3 RUNNING	I1-01	ETH	VFD 1.3	LCP-100
01-SI-104	INFLUENT PUMP 4 VFD1.4 SPEED FEEDBACK	I1-01	ETH	VFD 1.4	LCP-100
01-YN-104	INFLUENT PUMP 4 VFD1.4 IN REMOTE	I1-01	ETH	VFD 1.4	LCP-100
01-XA-104	INFLUENT PUMP 4 VFD1.4 FAULT	I1-01	ETH	VFD 1.4	LCP-100
01-HS-104	INFLUENT PUMP 4 VFD1.4 START/STOP	I1-01	ETH	VFD 1.4	LCP-100
01-SC-104	INFLUENT PUMP 4 VFD1.4 SPEED COMMAND	I1-01	ETH	VFD 1.4	LCP-100
01-YL-104	INFLUENT PUMP 4 VFD1.4 RUNNING	I1-01	ETH	VFD 1.4	LCP-100
01-SI-105	INFLUENT PUMP 5 VFD1.5 SPEED FEEDBACK	I1-01	ETH	VFD 1.5	LCP-100
01-YN-105	INFLUENT PUMP 5 VFD1.5 IN REMOTE	I1-01	ETH	VFD 1.5	LCP-100
01-XA-105	INFLUENT PUMP 5 VFD1.5 FAULT	I1-01	ETH	VFD 1.5	LCP-100
01-HS-105	INFLUENT PUMP 5 VFD1.5 START/STOP	I1-01	ETH	VFD 1.5	LCP-100
01-SC-105	INFLUENT PUMP 5 VFD1.5 SPEED COMMAND	I1-01	ETH	VFD 1.5	LCP-100
01-YL-105	INFLUENT PUMP 5 VFD1.5 RUNNING	I1-01	ETH	VFD 1.5	LCP-100
01-SI-106	INFLUENT PUMP 6 VFD1.6 SPEED FEEDBACK	I1-01	ETH	VFD 1.6	LCP-100
01-YN-106	INFLUENT PUMP 6 VFD1.6 IN REMOTE	I1-01	ETH	VFD 1.6	LCP-100
01-XA-106	INFLUENT PUMP 6 VFD1.6 FAULT	I1-01	ETH	VFD 1.6	LCP-100
01-HS-106	INFLUENT PUMP 6 VFD1.6 START/STOP	I1-01	ETH	VFD 1.6	LCP-100
01-SC-106	INFLUENT PUMP 6 VFD1.6 SPEED COMMAND	I1-01	ETH	VFD 1.6	LCP-100
01-YL-106	INFLUENT PUMP 6 VFD1.6 RUNNING	I1-01	ETH	VFD 1.6	LCP-100
05-SI-501	EFFLUENT PUMP 1 VFD 5.1 SPEED FEEDBACK	I5-01	ETH	VFD 5.1	LCP-100
05-YN-501	EFFLUENT PUMP 1 VFD 5.1 IN REMOTE	I5-01	ETH	VFD 5.1	LCP-100
05-XA-501	EFFLUENT PUMP 1 VFD 5.1 FAULT	I5-01	ETH	VFD 5.1	LCP-100
05-HS-501	EFFLUENT PUMP 1 VFD 5.1 START/STOP	I5-01	ETH	VFD 5.1	LCP-100
05-SC-501	EFFLUENT PUMP 1 VFD 5.1 SPEED COMMAND	I5-01	ETH	VFD 5.1	LCP-100
05-YL-501	EFFLUENT PUMP 1 VFD 5.1 RUNNING	I5-01	ETH	VFD 5.1	LCP-100
05-SI-502	EFFLUENT PUMP 2 VFD 5.2 SPEED FEEDBACK	I5-01	ETH	VFD 5.2	LCP-100
05-YN-502	EFFLUENT PUMP 2 VFD 5.2 IN REMOTE	I5-01	ETH	VFD 5.2	LCP-100
05-XA-502	EFFLUENT PUMP 2 VFD 5.2 FAULT	I5-01	ETH	VFD 5.2	LCP-100
05-HS-502	EFFLUENT PUMP 2 VFD 5.2 START/STOP	I5-01	ETH	VFD 5.2	LCP-100
05-SC-502	EFFLUENT PUMP 2 VFD 5.2 SPEED COMMAND	I5-01	ETH	VFD 5.2	LCP-100
05-YL-502	EFFLUENT PUMP 2 VFD 5.2 RUNNING	I5-01	ETH	VFD 5.2	LCP-100
05-SI-503	EFFLUENT PUMP 3 VFD 5.3 SPEED FEEDBACK	I5-01	ETH	VFD 5.3	LCP-100
05-YN-503	EFFLUENT PUMP 3 VFD 5.3 IN REMOTE	I5-01	ETH	VFD 5.3	LCP-100
05-XA-503	EFFLUENT PUMP 3 VFD 5.3 FAULT	I5-01	ETH	VFD 5.3	LCP-100
05-HS-503	EFFLUENT PUMP 3 VFD 5.3 START/STOP	I5-01	ETH	VFD 5.3	LCP-100
05-SC-503	EFFLUENT PUMP 3 VFD 5.3 SPEED COMMAND	I5-01	ETH	VFD 5.3	LCP-100
05-YL-503	EFFLUENT PUMP 3 VFD 5.3 RUNNING	I5-01	ETH	VFD 5.3	LCP-100
05-YN-504	EFFLUENT PUMP 4 RVSS 5.4 IN REMOTE	I5-01	DI	RVSS 5.4	LCP-100
05-XA-504	EFFLUENT PUMP 4 RVSS 5.4 FAULT	I5-01	DI	RVSS 5.4	LCP-100
05-HS-504	EFFLUENT PUMP 4 RVSS 5.4 START/STOP	I5-01	DO	RVSS 5.4	LCP-100
05-YL-504	EFFLUENT PUMP 4 RVSS 5.4 RUNNING	I5-01	DI	RVSS 5.4	LCP-100
05-YN-505	EFFLUENT PUMP 5 RVSS 5.5 IN REMOTE	I5-01	DI	RVSS 5.5	LCP-100
05-XA-505	EFFLUENT PUMP 5 RVSS 5.5 FAULT	I5-01	DI	RVSS 5.5	LCP-100
05-HS-505	EFFLUENT PUMP 5 RVSS 5.5 START/STOP	I5-01	DO	RVSS 5.5	LCP-100
05-YL-505	EFFLUENT PUMP 5 RVSS 5.5 RUNNING	I5-01	DI	RVSS 5.5	LCP-100
01-YL-100	INFLUENT GRINDER - RUNNING	I1-01	DI	GRINDER #1 CONTROL PANEL	LCP-100
01-XA-100	INFLUENT GRINDER - FAULT	I1-01	DI	GRINDER #1 CONTROL PANEL	LCP-100
01-YN-100	INFLUENT GRINDER - IN REMOTE	I1-01	DI	GRINDER #1 CONTROL PANEL	LCP-100
04-YL-400	COLLEGE PARK GRINDER - RUNNING	I4-01	DI	GRINDER #2 CONTROL PANEL	LCP-100
04-XA-400	COLLEGE PARK GRINDER - FAULT	I4-01	DI		LCP-100
04-YN-400	COLLEGE PARK GRINDER - IN REMOTE	I4-01	DI		LCP-100

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	SIGNAL FROM	SIGNAL TO
				DEVICE	DEVICE
01-LI-101	INFLUENT WETWELL LEVEL	I1-01	AI	EXISTING LIT-1.1	LCP-100
01-LAL-101	INFLUENT WETWELL LOW LEVEL SWITCH - PUMPS 1-4 CUTOFF	I1-01	DI	LSLL 1.5	LCP-100
01-LAL-102	INFLUENT WETWELL LOW LEVEL SWITCH - PUMPS 5-6 CUTOFF	I1-01	DI	LSLL 1.4	LCP-100
01-LAH-101	INFLUENT WETWELL HIGH-HIGH LEVEL SWITCH ALARM	I1-01	DI	LSHH 1.3	LCP-100
01-UA-101	GAS ALARM PANEL	I1-01	DI	AIT-1.1	LCP-100
01-XA-107	ATS IN EMERGENCY POSITION	I1-01	DI	ATS	LCP-100
01-YL-108	GENERATOR RUNNING	I1-01	DI	GENERATOR CONTROL PANEL	LCP-100
01-XA-109	GENERATOR FAULT	I1-01	DI	GENERATOR CONTROL PANEL	LCP-100
01-XA-110	GENERATOR LOW FUEL	I1-01	DI	GENERATOR CONTROL PANEL	LCP-100
01-XA-111	AIR CONDITIONER SMOKE DETECTED	I1-01	DI	AIR CONDITIOER	LCP-100
01-XA-112	AIR CONDITIONER FAULT	I1-01	DI	AIR CONDITIOER	LCP-100
01-XA-113	ELECTRICAL ROOM HIGH TEMPERATURE	I1-01	DI	THERMOSTATE	LCP-100
01-TSH-101	INFLUENT PUMP 1 HIGH TEMP (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.1 TSH	LCP-100
01-MSH-101	INFLUENT PUMP 1 MOISTURE (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.1 MSH	LCP-100
01-TSH-102	INFLUENT PUMP 2 HIGH TEMP (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.2 TSH	LCP-100
01-MSH-102	INFLUENT PUMP 2 MOISTURE (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.2 MSH	LCP-100
01-TSH-103	INFLUENT PUMP 3 HIGH TEMP (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.3 TSH	LCP-100
01-MSH-103	INFLUENT PUMP 3 MOISTURE (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.3 MSH	LCP-100
01-TSH-104	INFLUENT PUMP 4 HIGH TEMP (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.4 TSH	LCP-100
01-MSH-104	INFLUENT PUMP 4 MOISTURE (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.4 MSH	LCP-100
01-TSH-105	INFLUENT PUMP 5 HIGH TEMP (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.5 TSH	LCP-100
01-MSH-105	INFLUENT PUMP 5 MOISTURE (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.5 MSH	LCP-100
01-TSH-106	INFLUENT PUMP 6 HIGH TEMP (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.6 TSH	LCP-100
01-MSH-106	INFLUENT PUMP 6 MOISTURE (VIA miniCAS RELAY)	I1-01	DI	PUMP 1.6 MSH	LCP-100
05-TSH-501	EFFLUENT PUMP 1 HIGH TEMP (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.1 TSH	LCP-100
05-MSH-501	EFFLUENT PUMP 1 MOISTURE (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.1 MSH	LCP-100
05-TSH-502	EFFLUENT PUMP 2 HIGH TEMP (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.2 TSH	LCP-100
05-MSH-502	EFFLUENT PUMP 2 MOISTURE (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.2 MSH	LCP-100
05-TSH-503	EFFLUENT PUMP 3 HIGH TEMP (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.3 TSH	LCP-100
05-MSH-503	EFFLUENT PUMP 3 MOISTURE (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.3 MSH	LCP-100
05-TSH-504	EFFLUENT PUMP 4 HIGH TEMP (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.4 TSH	LCP-100
05-MSH-504	EFFLUENT PUMP 4 MOISTURE (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.4 MSH	LCP-100
05-TSH-505	EFFLUENT PUMP 5 HIGH TEMP (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.5 TSH	LCP-100
05-MSH-505	EFFLUENT PUMP 5 MOISTURE (VIA miniCAS RELAY)	I5-01	DI	PUMP 5.5 MSH	LCP-100
PUMP STATION REMOTE CONTROL PANEL (RCP-100)					
05-LI-501	EFFLUENT WETWELL LEVEL	I5-01	AI	EXISTING LIT-5.1	RCP-100
05-LAL-501	EFFLUENT WETWELL LOW LEVEL SWITCH - PUMPS CUTOFF	I5-01	DI	LSLL 5.1	RCP-100
05-LAH-501	EFFLUENT WETWELL HIGH-HIGH LEVEL SWITCH ALARM	I5-01	DI	LSHH 5.1	RCP-100
05-PI-501	EFFLUENT HEADER PRESSURE	I5-01	AI	PIT 5.0	RCP-100
05-FI-501	EFFLUENT FLOW	I5-01	AI	FIT 5.0	RCP-100
04-FI-401	WEST CHANNEL FLOW	I4-01	AI	EXISTING FIT-3.2	RCP-100
04-FI-402	EAST CHANNEL FLOW	I4-01	AI	EXISTING FIT-3.2	RCP-100
04-AI-403	RAIN	I4-01	AI	EXISTING FIT-3.2	RCP-100
04-ZO-401	SLIDGE GATE 4.1 100% OPEN	I4-01	DI	SLIDE GATE 4.1 ACTUATOR	RCP-100
04-ZC-401	SLIDGE GATE 4.1 100% CLOSED	I4-01	DI	SLIDE GATE 4.1 ACTUATOR	RCP-100
04-YN-401	SLIDGE GATE 4.1 IN REMOTE	I4-01	DI	SLIDE GATE 4.1 ACTUATOR	RCP-100
04-XA-401	SLIDGE GATE 4.1 FAULT	I4-01	DI	SLIDE GATE 4.1 ACTUATOR	RCP-100
04-HS-401	SLIDGE GATE 4.1 CALL TO OPEN	I4-01	DO	SLIDE GATE 4.1 ACTUATOR	RCP-100
04-HS-401	SLIDGE GATE 4.1 CALL TO CLOSE	I4-01	DO	SLIDE GATE 4.1 ACTUATOR	RCP-100
04-ZO-402	SLIDGE GATE 4.2 100% OPEN	I4-01	DI	SLIDE GATE 4.2 ACTUATOR	RCP-100
04-ZC-402	SLIDGE GATE 4.2 100% CLOSED	I4-01	DI	SLIDE GATE 4.2 ACTUATOR	RCP-100
04-YN-402	SLIDGE GATE 4.2 IN REMOTE	I4-01	DI	SLIDE GATE 4.2 ACTUATOR	RCP-100
04-XA-402	SLIDGE GATE 4.2 FAULT	I4-01	DI	SLIDE GATE 4.2 ACTUATOR	RCP-100
04-HS-402	SLIDGE GATE 4.2 CALL TO OPEN	I4-01	DO	SLIDE GATE 4.2 ACTUATOR	RCP-100
04-HS-402	SLIDGE GATE 4.2 CALL TO CLOSE	I4-01	DO	SLIDE GATE 4.2 ACTUATOR	RCP-100
04-ZO-403	SLIDGE GATE 4.3 100% OPEN	I4-01	DI	SLIDE GATE 4.3 ACTUATOR	RCP-100
04-ZC-403	SLIDGE GATE 4.3 100% CLOSED	I4-01	DI	SLIDE GATE 4.3 ACTUATOR	RCP-100
04-YN-403	SLIDGE GATE 4.3 IN REMOTE	I4-01	DI	SLIDE GATE 4.3 ACTUATOR	RCP-100
04-XA-403	SLIDGE GATE 4.3 FAULT	I4-01	DI	SLIDE GATE 4.3 ACTUATOR	RCP-100
04-HS-403	SLIDGE GATE 4.3 CALL TO OPEN	I4-01	DO	SLIDE GATE 4.3 ACTUATOR	RCP-100
04-HS-403	SLIDGE GATE 4.3 CALL TO CLOSE	I4-01	DO	SLIDE GATE 4.3 ACTUATOR	RCP-100
04-YL-404	BAR SCREEN #1 RUNNING	I4-01	DI	SCREENING CONTROL PANEL	RCP-100
04-XA-404	BAR SCREEN #1 FAULT	I4-01	DI	SCREENING CONTROL PANEL	RCP-100
04-YN-404	BAR SCREEN #1 IN REMOTE	I4-01	DI	SCREENING CONTROL PANEL	RCP-100
04-YL-405	BAR SCREEN #2 RUNNING	I4-01	DI	SCREENING CONTROL PANEL	RCP-100

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	SIGNAL FROM	SIGNAL TO
				DEVICE	DEVICE
04-XA-405	BAR SCREEN #2 FAULT	I4-01	DI	SCREENING CONTROL PANEL	RCP-100
04-YN-405	BAR SCREEN #2 IN REMOTE	I4-01	DI	SCREENING CONTROL PANEL	RCP-100
04-YL-406	CONVEYOR RUNNING	I4-01	DI	SCREENING CONTROL PANEL	RCP-100
04-XA-406	CONVEYOR FAULT	I4-01	DI	SCREENING CONTROL PANEL	RCP-100
04-YN-406	CONVEYOR IN REMOTE	I4-01	DI	SCREENING CONTROL PANEL	RCP-100

SECTION 17211

PROCESS TAPS AND PRIMARY ELEMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies general requirements which are applicable to all process instrumentation systems consisting of process sensors, monitoring and control instruments, and accessories required to provide a complete and functional monitoring and control system.
- B. Work Included:
 - 1. The Contractor shall provide, calibrate, and test the complete process instrumentation system. The Contractor shall also place the completed system in operation including tuning loops and make final adjustments to instruments as required during plant start-up. The Contractor shall provide the services of instrument technicians for testing and adjustment activities.
 - 2. The Contractor shall examine the mechanical drawings and specifications to determine actual locations, sizes, materials and ratings of process connections.
- C. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.
- D. Operating Requirements:
The devices specified in this section quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories.
- E. Related Work Specified Elsewhere:
Division 1 General Requirements

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Flow calculation for each differential-type flow element.
- B. In accordance with paragraph 17000 1.3 D, record documentation shall include the data sheets specified in this section.
- C. Data sheets for all instruments and accessories to be provided. Data sheets shall be in accordance with ISA-20. All applicable entries on the data sheet shall be completed.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements
- B. Manufacturer:
Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.
- C. Installer:
Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.
- D. References:
References are listed in Section 17000. They are a part of this section as specified and modified.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION SPECIFICATION DATA SHEETS (INSTRUSPEC)

Specific requirements for instruments included in this section are listed on INSTRUSPEC sheets in paragraph 3.3 of this section. All instrument functions specified on this list shall be provided. Additional instruments may be required to complete the instrument loops because of certain characteristics of the particular equipment provided. Such additional instruments shall be provided at no additional cost even though not specified in the Instrument Schedule or on the Contract Drawings.

2.2 TUBING AND TUBING FITTINGS

- A. Instrument tubing between the process connection and instruments shall be ½ inch x 0.035 inch seamless annealed ASTM A269 type 316 stainless steel.
- B. Tubing fittings shall be type 316 stainless steel and shall be the double-ferrule swage type. Flare, ball sleeve compression or single-ferrule swage type are not acceptable. Fittings shall be Crawford "Swagelok", Hoke "Gyrolok", or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:

General requirements for the installation of primary elements specified in this section are listed on INSTRUSPEC sheets in paragraph 3.3 of this section and shown on the contract drawings.
- B. Process Connections:

Unless otherwise specified, process taps shall comply with API RP550. Root valves shall be provided at taps, except temperature taps and pump discharge pressure taps. Process connections shall be arranged, where possible, such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment. Where process taps are not readily accessible from instrument locations, a block valve shall be provided at the instrument. Block valves shall also be provided for each instrument where multiple instruments are connected to one process tap.
- C. Tubing:

Tubing shall be installed on supports spaced not more than 3 feet apart and shall run parallel or perpendicular to walls structural members, or intersections of vertical planes and the ceiling. Unless otherwise shown, tubing shall follow building surfaces closely or shall be carried in trays or conduit. Tubing shall not be supported from piping or equipment except at process taps or connections to the device served. Tubes supported directly on concrete surfaces shall be spaced at least ½-inch from the concrete. Tubing support shall be one-hole malleable iron clamps with clamp backs as required. Bends shall be formed to uniform radii without flattening. Ends of tubing shall be square-cut and deburred before installation in fittings. Fittings shall be used for splices, connections, and turns near final connections. Bulkhead fittings shall be used when tubing enters a panel.
- D. Signal Transmission:

1. Signal transmission between electric or electronic instruments not located within a common panel shall be 4 to 20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Milliampere signals from field shall be converted to a 1 to 5 volt signal by dropping across a 0.1%, 250 ohm, 1/2 watt resistor at the external terminals of each panel. All instruments within the panel shall be parallel wired. Measurement loops shall be grounded at external terminals by bonding to the instrument panel signal ground bus. Isolating amplifiers for field equipment possessing a grounded input or output shall be provided.
2. High frequency (greater than 1 kHz) pulse rate signals from field transmitters shall be converted to DC voltage signals at the panel.
3. Platinum resistance temperature detector (RTD) outputs shall be carried to the control panel and converted to a dc voltage signal unless otherwise specified or shown.
4. All other transmission systems, such as impulse duration, low frequency pulse rate, and voltage regulated, will not be permitted except where specifically noted in the instrument schedule, paragraph 3.03 of this section. When transmitters with non-standard outputs are specified, their output shall be converted to 4 to 20 milliamperes at the field instrument.
5. Two wire equipment located in hazardous areas shall be made safe for the specified conditions by use of equipment and barriers approved by Underwriters Laboratories, Inc. (UL), Canadian Standards Association (CSA), or Factory Mutual (FM).

3.2 TESTS AND INSPECTIONS

A. General Requirements:

Materials, equipment, and construction included under this specification shall be inspected in accordance with the procedures set forth in the General and Special Conditions sections of the Contract Documents, Section 17000, and this section. Testing shall be performed in accordance with Section 17000, this section, and subsequent sections of this division.

B. Installed Tests and Inspection:

1. Test Reports: Test reports shall conform to the requirements of section 17000.
2. Test Equipment: Test equipment used to simulate inputs and read outputs shall have a rated accuracy at the point of measurement at least three times greater than the component under test. Each test instrument shall be calibrated prior to the commencement of a testing activity and at the completion of a testing activity. Certified calibration reports traceable to the National Bureau of

Standards shall be included with the test report. Buffer solutions and reference fluids shall be provided as necessary for tests of analytical equipment.

3. Testing Stages:

- a. General: Each instrument loop shall be tested in the following sequence:

Testing sequence	Form reference
Wiring	Section 17000-A
Individual components	Section 17000-B thru I
Individual loops	Section 17000-J
Loop commissioning	Section 17000-K

Testing of piping and wiring and individual components shall be completed with certified test reports provided to the Engineer prior to commencement of individual loop testing, which shall be completed with certified test reports provided to the Engineer prior to commencement of loop commissioning.

- b. Individual Component Calibration and Test: Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure. Instruments shall then be tested in compliance with ISA S51.1 and the data entered on the applicable test report form. Alarm trips, control trips, and switches shall be set to initial values specified in paragraph 3.03 of this section at this time. Final elements shall be checked for range, dead band, and speed of response.

Any component which fails to meet the required tolerances shall be repaired by the manufacturer or replaced, and the above tests repeated until the component is within tolerance.

- c. Loop Test: Each instrument loop shall be tested as an integrated system. This test shall check operation from transmitter to readout components. Signals shall be injected at the signal connection to primary measuring elements.

If any output device fails to indicate properly, corrections to the loop circuitry shall be made as necessary and the test repeated until all instruments operate properly

- d. Closed Loop Commissioning Test: Commissioning test shall demonstrate stable operation of the loop under actual

plant operating conditions. This test shall include adjustment of loop tuning parameters.

Tuning parameters (proportional gain, integral time constant, and derivative time constant) for each control loop shall be adjusted to provide 1/4 amplitude damping unless otherwise specified. A chart recording showing loop response to a step disturbance shall be provided for each loop. Two charts shall be made for cascade loops, one showing the secondary loop response with its set point on manual, and the second showing overall loop response. Each control loop with "batch" feature shall be adjusted to provide optimum response following start-up from an integral action saturation condition. Chart recording shall be provided showing this response. Chart recordings shall be made at sufficient speed and amplitude to clearly show 1/4 amplitude damping and shall be annotated to show loop number and title, and settings of parameters and set point.

3.3 SUPPLEMENTS

- A. The supplements listed below, following the "End of Section" designation, are part of this Specification section.
- B. Instrumentation Data Sheets.

END OF SECTION

SECTION 17212

LEVEL SWITCH - FLOAT

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, all float switches listed below:

INST. No.	Dwg No.	DESCRIPTION	LOCATION	TYPE
LSHH 1.3	I1-01	High Level Alarm	Influent Wetwell	Float Switch
LSLL 1.4	I1-01	Low Level Pump Cutoff	Influent Wetwell	Float Switch
LSLL 1.5	I1-01	Low Level Pump Cutoff	Influent Wetwell	Float Switch
LSHH 4.0	I4-01	High Level Alarm - Open Bypass Gate	Screenings Channel	Float Switch
LSHH 5.1	I5-01	High Level Alarm	Effluent Wetwell	Float Switch
LSLL 5.1	I5-01	Low Level Pump Cutoff	Effluent Wetwell	Float Switch

1.2 SUBMITTALS

- A. Submit product data in accordance with these Specifications.

1.3 SPARE PARTS

- A. Provide 1 spare float switch with 50 foot cable. The spare shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

PART 2 PRODUCTS

2.1 LEVEL SWITCH - FLOAT

- A. Type: Submersible coated 316 stainless steel, polypropylene, or polyethylene body; non-mercury switch contact rated 4 amps at 120 VAC; normally open, normally closed, or Form C (N.O. and N.C.) contact configuration as indicated. Mercury float switches are not acceptable.
- B. Cable: Minimum 18 gauge, 300 volt (minimum) rated; heavy-duty type SOW or equivalent. Provide sufficient length for mounting at the elevations indicated. See mechanical drawings for elevations.
- C. Cable length: Field coordinate with installation with mounting height. See mechanical drawings for mounting height.
- D. The Contractor shall ensure mounting is in accordance with the manufacturer's recommendations.

- E. Acceptable Manufacturers: Equal to Warrick Series M, Anchor Scientific.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Junction Box: Provide NEMA 4X stainless steel junction box, mounted near the switch, for terminating vendor supplied cable and discrete control wiring to control panel.
- B. The Contractor shall ensure mounting is in accordance with the manufacturer's recommendations.
- C. The Contractor shall install at level shown on the contract documents.
- D. Instrument Tagging: Provide stainless steel identification tag.
- E. Secure floats at junction box with stainless steel supporting kellum grips/stainless steel wire.

3.2 FIELD QUALITY CONTROL

- A. Tests and Calibration
 - 1. Perform continuity and insulation resistance tests on instrumentation conductors.

3.03 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.
- B. An operational and maintenance manual shall be provided.

END OF SECTION

SECTION 17213

GAGE PRESSURE TRANSMITTER

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, the gage pressure transmitters listed below:

INST. No.	Dwg No.	DESCRIPTION	LOCATION	TYPE			SIGNAL TYPE
					RANGE	QTY.	
PIT 5.0	15-01	24" Effluent Force Main Pressure	24" DIP	Gauge Pressure Transmitter	0-150	PSI	4-20 mA

1.2 QUALITY ASSURANCE

- A. The equipment and materials to be furnished under this Contract shall be new and of first quality.
- B. The manufacturer of each piece of equipment shall be responsible for furnishing, supervising installation, testing, calibration and start-up of the systems.

1.3 SUBMITTALS

- A. Submit product data in accordance with these specifications.

1.4 SPARE PARTS

- A. One complete set of spare parts as recommended by manufacturer for each installation shall be furnished.

1.5 WARRANTY

- A. A period of one (1) year commencing upon equipment acceptance by the OWNER and Engineer.
- B. The warranty shall cover all equipment, components and systems provided with each control system.
- C. The warranty shall provide for replacement and/or repair of faulty or defective components at no cost to the OWNER during the WARRANTY period.
- D. Where deemed necessary, the manufacturer will be responsible for the labor of removal and reinstalling the defective or faulty components without cost to the OWNER.

PART 2 PRODUCTS

2.1 GAGE PRESSURE TRANSMITTER

- A. A gage transmitter, complete with two valve manifold, shall be supplied to monitor in-line pressure.
- B. The transmitter shall be a Rosemount Model 3051S gage pressure transmitter and conform to the following specifications:
 - a. Accuracy: Up to 0.025% of Span
 - b. Stability: Up to +/- 0.15% of Upper Range Limit
 - c. Rangedown: Up to 200:1
 - d. Connection Type: In-Line
 - e. Measurement Type: Gage
 - f. Pressure Range: -14.7 to 150 PSI
 - g. Isolating Diaphragm: 316L SST
 - h. Process Connection: Assemble to Rosemount 306 Integral Manifold
 - i. Transmitter Output: 4-20 mA with digital signal based on HART protocol
 - j. Housing Style: PlantWeb Housing, Aluminum, 1/2" – 14 NPT Conduit entry
 - k. Display Type: PlantWeb LCD Display
 - l. Mounting Bracket: All SST, 2-in. pipe and panel
 - m. Stainless Steel Tag with Loop Number and Calibration (0 to 150 PSI)
 - n. Provide Rosemount Model #3051S1TG2A2A11A1AB4E5M5
- C. Transmitter shall be equipped with a 316 SS 2-valve threaded instrument manifold conforming to the following specifications:
 - a. Manifold Style: Threaded
 - b. Manifold Type: 2-Way
 - c. Body: 316 SST/316L SST
 - d. Bonnet: 316 SST
 - e. Stem and tip/ball: 316 SST
 - f. Process Connection Style: 1/2 – 14 ANPT Female for Inline Transmitter
 - g. Packing Material: PTFE
 - h. Valve Seat: Integral
 - i. Provide Rosemount Model #0306RT22BA11
- D. Installation: Installation procedures shall be per the manufacturer's recommendations. The installation locations are as shown on the contract drawings.

PART 3 EXECUTION

3.01 START-UP SERVICE

- A. Provide manufacturer's Field Service Technician (certified, factory trained) for a minimum of one 8-hour days on site. Field Service Technician shall calibrate

instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related items as required to ensure that filter controls are performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.

- B. Field Service Technician will verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.
- C. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.02 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.
- B. An operational and maintenance manual shall be provided in accordance with these specifications.

END OF SECTION

SECTION 17214

TRANSIT TIME ULTRASONIC FLOW METER

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, the flow transmitters listed below:

INST. No.	Dwg No.	DESCRIPTION	LOCATION	TYPE			SIGNAL TYPE
					RANGE	QTY.	
FIT 5.0	I5-01	24" Effluent Force Main Flow	24" DIP	Signal Converter	0-6	MGD	4-20 mA
FE 5.0	i5-01	Clamp On Transducers	24" DIP	Obstructionless Wetted			

1.2 QUALITY ASSURANCE

- A. The equipment and materials to be furnished under this Contract shall be new and of first quality.
- B. The manufacturer of each piece of equipment shall be responsible for furnishing, supervising installation, testing, calibration and start-up of the systems.

1.3 SUBMITTALS

- A. Submit product data in accordance with these specifications.

1.4 SPARE PARTS

- A. One complete set of spare parts as recommended by manufacturer for each installation shall be furnished.

1.5 WARRANTY

- A. A period of one (1) year commencing upon equipment acceptance by the OWNER and Engineer.
- B. The warranty shall cover all equipment, components and systems provided with each control system.
- C. The warranty shall provide for replacement and/or repair of faulty or defective components at no cost to the OWNER during the WARRANTY period.

- D. Where deemed necessary, the manufacturer will be responsible for the labor of removal and reinstalling the defective or faulty components without cost to the OWNER.

PART 2 PRODUCTS

2.1 TRANSIT TIME WITH CLAMP ON FLOW TRANSDUCERS

- A. Instrument Function: Flow Measurement
- B. Instrument Description: Transit Time Ultrasonic Flowmeter
- C. Power Supply: 120 Vac, 60-Hertz nominal
- D. Signal Input Process
- E. Signal Output: 4-20 mA
- F. Signal Converter/Indicating Transmitter:
 - 1. Processor: selectable algorithms to calculate open channel flow, full pipe flow, partially full flow.
 - 2. Indicator: LCD indicator, scaled in engineering units.
 - 3. Accuracy: 0.5% of flow
 - 4. Analog Inputs: One 4-20 mA (water level input)
 - 5. Analog Outputs: Two 4-20 mA, isolated, into a minimum of 600.
 - 6. Discrete Outputs: Two Form-C rated at a minimum of 1A at 240 Vac, non-inductive.
 - 7. Pulse Output: FET open collector: 0-2500 Hertz at 1A.
 - 8. Networks: MODBUS via RS-232 or RS-485 port.
 - 9. Software: Configure the flowmeter and retrieve and display real-time and stored data.
 - 10. Enclosure: NEMA 4X 316 Stainless Steel
 - 11. Acceptable Manufacturer:
 - a. Accusonics Model 7510
 - b. GE Panametrics Model DF868
 - c. Proline Prosonics
 - d. Accepted equal.
 - 12. Sensor:
 - a. Operational Frequency: 1 MHz
 - b. Pressure Limit: 1000 psi
 - c. Temperature Limits: -32 to +250 °F.

- d. Wetted Materials: Stainless Steel
- e. Pipe Sizes: 24"
- f. Transducer cable: Field measured prior to purchase.

G. Execution:

1. Installation: Install in accordance with manufacturer's instructions and the Engineer's installation detail.
2. Supplier/Subcontractor to verify size and type of specified pipe connection with approved piping submittals.

H. Installation: Installation procedures shall be per the manufacturer's recommendations. The installation locations are as shown on the contract drawings.

PART 3 EXECUTION

3.01 START-UP SERVICE

- A. Provide manufacturer's Field Service Technician (certified, factory trained) for a minimum of one 8-hour days on site. Field Service Technician shall calibrate instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related items as required to ensure that filter controls are performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.
- B. Field Service Technician will verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.
- C. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.02 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.

- B. An operational and maintenance manual shall be provided in accordance with these specifications.

END OF SECTION

SECTION 17215

COMBUSTIBLE GAS DETECTOR

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, the combustible gas detectors listed below:

INST. No.	Dwg No.	DESCRIPTION	LOCATION	TYPE	SIGNAL TYPE
AIT 1.5	I1-01	Gas Sampling Panel w/ Alarm	Influent Wetwell	Alarm Panel	Discrete
AE 1.1	I1-01	Combustible Gas Sensor	Influent Wetwell	Sensor	

1.2 QUALITY ASSURANCE

- A. The equipment and materials to be furnished under this Contract shall be new and of first quality.
- B. The manufacturer of each piece of equipment shall be responsible for furnishing, supervising installation, testing, calibration and start-up of the systems.

1.3 SUBMITTALS

- A. Submit product data in accordance with these specifications.

1.4 SPARE PARTS

- A. One complete set of spare parts as recommended by manufacturer for each installation shall be furnished.

1.5 WARRANTY

- A. A period of one (1) year commencing upon equipment acceptance by the OWNER and Engineer.
- B. The warranty shall cover all equipment, components and systems provided with each control system.
- C. The warranty shall provide for replacement and/or repair of faulty or defective components at no cost to the OWNER during the WARRANTY period.

- D. Where deemed necessary, the manufacturer will be responsible for the labor of removal and reinstalling the defective or faulty components without cost to the OWNER.

PART 2 PRODUCTS

2.1 Combustible Gas Detector

- A. Instrument Function: Combustible Gas Measurement
- B. Power Supply: 120 Vac, 60-Hertz nominal
- C. Gas Type: Combustible (LEL)
- D. Signal Output: Alarm Outputs / 125VAC / 5Amp & 4-20Ma
- E. Battery Life: 2 Hours (All Options)
- F. Indicator: LCD indicator, scaled in engineering units.
- G. Accuracy: +/- 2% FS
- H. Step Range Response: <12 seconds
- I. Enclosure: NEMA 4X **RATED FOR HAZARDOUS LOCATION**
- J. Internal pump and tubing to draw air form 15 feet below
- K. Ddate of last successful calibration, replace sensor indication, real-time clock, and logging
- L. Audible Alarm and Large LED Visual Alarms
- M. Acceptable Manufacturer:
 - a. MSA Toxgard II
 - b. Drager equal.
- N. Sensor:
- O. Execution:
 - 1. Installation: Install in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 START-UP SERVICE

- A. Provide manufacturer's Field Service Technician (certified, factory trained) for a minimum of one 8-hour days on site. Field Service Technician shall calibrate instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related items as required to ensure that filter controls are performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.
- B. Field Service Technician will verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.
- C. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.02 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.
- B. An operational and maintenance manual shall be provided in accordance with these specifications.

END OF SECTION

SECTION 17260

PROCESS CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, start-up and place into satisfactory operation all process control panels and enclosures
- B. Related Sections:
 - 1. Section 01600, General Material & Equipment Requirements.
 - 2. Section 03055, Concrete.
 - 3. Section 17000, Instrumentation, Control and Monitoring System General Requirements.
 - 4. Section 17100, Loop Descriptions.
 - 5. Section 17275, Miscellaneous Panel Instruments.

1.2 QUALITY ASSURANCE

- A. Standards, Codes and Regulations:
 - 1. Construction of panels and the installation and interconnection of all equipment and devices mounted within shall comply with applicable provisions of the following standards, codes and regulations:
 - a. National Fire Protection Association 79, Annex "D" Standards, (NFPA).
 - b. National Electrical Code, (NEC).
 - c. National Electrical Manufacturer's Association Standards, (NEMA).
 - d. American Society for Testing and Materials, (ASTM).
 - e. Operational Safety and Health Administration Regulations, (OSHA).
 - f. Underwriters' Laboratory, Inc., (UL).
 - g. State and Local code requirements.
 - h. Where any conflict arises between codes or standards, the most stringent requirement shall apply.
 - 2. All material and equipment shall be new and all panels shall be built in an Underwriters' Laboratory, Inc (UL) approved panel shop and bear the UL label.

- B. General Design Requirements:
1. Comply with the requirements of Section 17000, Instrumentation, Control and Monitoring System General Requirements.
 2. Comply with the control descriptions of Section 17100, Loop Descriptions.
- C. Factory Inspection:
- Inspect each panel, console, device, and cabinet before testing and before shipping. Inspection shall include, but not be limited to the following:
1. Verify all “Approved as Corrected” comments on Shop Drawings were implemented.
 2. Verify presence of and accuracy of nameplates and tags.
 3. Verify that wire sizes and color-coding comply with the Contract Documents.
 4. Verify presence of terminal blocks, terminal block numbers, and required quantity of spares.
 5. Verify annunciator window engravings and quantity of spare windows comply with the Contract Documents.
 6. Verify proper wiring practices and grounding.
 7. Verify enclosure flatness, finish, and color.
 8. Verify anchoring of wire bundles between subpanels and front panel-mounted devices.
 9. Verify presence of applicable items specified in this Section.
 10. Check and verify software licenses for latest release and license types.
- D. Panel Operational Testing:
1. Test all input/output components to verify that internal panel wiring is properly terminated at correct locations. Verify initial ranges and settings.
 2. Test all system hardware and software to verify proper operation as stand-alone units. Test shall include, but not be limited to, the following:
 - a. Power distribution and breaker ratings to match approved Shop Drawings.
 - b. Power fail/restart tests.
 - c. Diagnostics checks.
 - d. Demonstrate that all specified equipment functional capabilities are working properly.
 3. Test components and devices requiring data transmission to verify that communication between such components is working properly. Verify communication by using the same media required for the completed system at the Site as indicated in the Contract Documents.

4. Perform integrated system test with all system equipment and simulated inputs/outputs connected to verify that equipment is performing properly as an integrated system.
5. Simulation devices shall be of suitable quality to not mask control panel defects.

1.3 SUBMITTALS

Comply with the requirements of Section 17000, Instrumentation, Control and Monitoring System General Requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

Comply with the requirements of Section 17000, Instrumentation, Control and Monitoring System General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION REQUIREMENTS

- A. Provide all electrical and/or pneumatic components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels and/or enclosures complete and operational.
- B. Locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item.
- C. Components for installation on panel exterior shall be located generally as shown. Layouts shall be submitted for review in accordance with Section 17000, Instrumentation, Control and Monitoring System General Requirements.
- D. Where permitted by location and layout as shown, panels and enclosures shall have full height rear access doors. Where rear doors are not possible, panels shall have full or half height front access doors.
- E. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.
- F. Provide sub-panels for installation of all relays and other internally mounted components.
- G. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.

- H. Provide copper grounding studs for all panel equipment.
- I. Provide the following convenience accessories inside of each control panel:
 - 1. One 120 VAC, 20A duplex, grounding type receptacle.
 - 2. One or more 120 VAC fluorescent light fixtures with 40 watt lamp and protective plastic shield to span across the width of the panel but not less than two-thirds the width of the panel, as a minimum.
 - 3. One 120 VAC, 20A, snap switch, to turn on the light, mounted in an outlet box with a cover and located so that it is easily accessible from access door.
 - 4. Service light with switch and duplex receptacle shall have its own circuit breaker and separate power feed.
- J. The bottom 12-inches of free standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing.
- K. No device shall be mounted less than 36-inches above the operating floor level, unless otherwise specified.
- L. Separate and shield low voltage signal wiring from power and control wiring by a minimum of 6-inches.
- M. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

2.2 IDENTIFICATION

- A. Provide laminated plastic nameplates for identification of panels and components mounted thereon as follows:
 - 1. Nameplates shall be of 3/32-inch thick laminated phenolic type with white matte finish surface and black letter engraving.
 - 2. Panel identification nameplates to have 1/2-inch high letter engravings.
 - 3. Panel mounted component (e.g., control devices, indicating lights, selector switches, etc.) identification nameplates to have 1/4-inch high letter engravings.
 - 4. Nameplates shall be attached to the panel face with two stainless steel self-tapping screws.
 - 5. Nameplate engravings shall include the instrument or equipment tag number and descriptive title as shown and specified.

- B. Tag all internally mounted instruments in accordance with the following requirements:
 - 1. Tag numbers shall be as listed in the Instrument Index.
 - 2. The identifying tag number shall be permanently etched or embossed onto a stainless steel tag which shall be fastened to the device housing with stainless steel rivets or self tapping screws of appropriate size.
 - 3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter stainless steel wire rope.
 - 4. Identification tag shall be installed so that the numbers are easily visible to service personnel.
 - 5. Front of panel mounted instruments shall have the tag attached to rear of device.
- C. Tagging of the following items shall be accomplished with the use of adhesive plastic Brady USA, Inc. labels, or equal.
 - 1. Tag all electrical devices (e.g., relays, timers, power supplies) mounted within control panels and enclosures.
 - 2. Tag all pneumatic lines
 - 3. Numerically tag all terminal blocks.
 - 4. Color code and numerically tag wiring at each end.

2.3 PANELS AND ENCLOSURES

- A. General:
 - 1. Panels and enclosures shall meet the NEMA requirements for the type specified.
 - 2. Sizes shown are estimates. CONTRACTOR shall furnish panels and enclosures amply sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring, tubing and other components installed within, as required.
- B. Construction Features:
 - 1. Control panels located inside control or electrical room areas shall be NEMA 12 rated:
 - a. Fabricate enclosures using minimum 14-gage steel for wall or frame mounted enclosures and minimum 12-gage for free standing enclosures. Steel shall be free of pitting and surface blemishes.
 - b. Continuously weld all exterior seams and grind smooth. Also, surface grind complete removal of corrosion, burrs, sharp edges and mill scale.
 - c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.

- d. Panel shall be flat within 1/16-inch over a 24-inch by 24-inch area, or flat within 1/8-inch for a larger surface. Flatness shall be checked by using a 72-inch long straight edge. Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.
- e. Use pan type construction for doors. Door widths shall not exceed 36-inches.
- f. Mount doors with full-length heavy-duty piano hinge with stainless steel hinge pins.
- g. Provide oil resistant gasket completely around each door or opening.
- h. Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.
- i. Use stainless steel fasteners throughout.
- j. Provide interior mounting panels and shelves constructed of minimum 12-gage steel with a white enamel finish.
- k. Provide steel print pocket with white enamel finish.
- l. Provide enclosure mounting supports as required for floor, frame, or wall mounting.
- m. Provide all holes and cutouts for installation of conduit and equipment. Cable and piping to enter the enclosure through the bottom, unless otherwise noted. All conduit and piping openings and all conduits shall be sealed watertight.
- n. Completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease and dirt. Zinc phosphatize for corrosion protection.
- o. One coat of primer shall be applied to all interior and exterior surfaces immediately after corrosion protection has been applied. Exterior surfaces shall then be given sufficient coats of primer surfacer, applied with sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.
- p. All interior surfaces shall be painted with two coats of semi-gloss white polyurethane enamel.
- q. All exterior surfaces shall be painted with a minimum of three finish coats of polyurethane enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected by ENGINEER from complete selection of standard and custom color charts furnished by the manufacturer. Provide one extra quart of touch-up paint for each exterior finish color.
- r. Primer and finish paint shall be compatible and shall be a low VOC, high solids polyurethane enamel, Hi-Solids

s. Provide one extra quart of touch-up paint for each exterior finish color.

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- d. Corrosion resistant polyester quick release latches shall be provided.
- e. No extra holes or knockouts shall be provided. No light or convenience outlet need be provided.

C. Electrical Systems:

1. Control of Environment:

a. Outdoor Panels:

- 1) Provide adequately sized automatically controlled 120 VAC strip heaters to maintain temperature inside each enclosure above 40°F to maximum of 80°F when the outside temperature is -20°F through 40° F.
- 2) Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure. Air conditioner shall have a minimum capacity of 4,000 BTU. Housing shall be constructed of corrosion resistant materials.
- 3) Provide thermostats to automatically control heating and cooling requirements without need of manual operation of a heating/cooling transfer switch.
- 4) Provide documentation if any of the above is deemed unnecessary.

b. Indoor Panels:

- 1) Provide adequately sized, automatically controlled 120 VAC strip heaters to maintain temperature 10°F above ambient for condensation prevention inside panels.
- 2) Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure. Air conditioner shall have a minimum capacity of 4,000 BTU.
- 3) Provide documentation if any of the above is deemed unnecessary.

2. Power Source and Internal Power Distribution:

- a. General: Control panel power supply source, type, voltage, number of circuits and circuit ratings shall be as shown.
- b. Panels shall be provided with an internal 120 VAC power distribution panel with number of circuits and separate

circuit breakers sized as required to distribute power to the panel components. Distribution panel shall contain two spare breakers, minimum.

3. Wiring:

- a. Internal wiring shall be Type MTW and THW stranded copper wire with thermoplastic insulation rated for 600 V at 90°C for single conductors, color coded and labeled with wire identification.
- b. For DC panel signal wiring, use No. 18 minimum AWG shielded.
- c. For DC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 A, use sizes required by NEC standards.
- d. Separate and shield low voltage signal wiring from power and control wiring by a minimum of 6-inches.
- e. Group or bundle parallel runs of wire using covered troughs. Maximum bundle size to be 1-inch. Troughs shall have 40 percent spare capacity.
- f. Install wire troughs along horizontal or vertical routes to present a neat appearance. Angled runs are not acceptable.
- g. Adequately support and restrain all wiring runs to prevent sagging or other movement.
- h. Terminate internal panel wiring using tube insulated crimp-on connectors; soldered connectors are unacceptable. Use screw type terminal blocks 600-volt rated, mounted on DIN rails. Fused terminal blocks shall have LED blown fuse indication. Terminal blocks for 4-20 mA signals shall be fused and knife-disconnect terminal blocks. Terminal strips shall be identified as specified in this section. Identifiers shall be self-stick, plastic tape strips with permanent type, machine printed numbers. Hand-written labels are not acceptable. Provide Phoenix Contact, Entrelec or Allen Bradley.
- i. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.
- j. All alarms generated external to the panel, spare alarm, and repeat contacts shall be wired out to terminal blocks.
- k. For internal component-to-component wiring only, compression type terminal blocks are acceptable.
- l. Provide spare terminals equal in number to 20 percent of the terminals used for each type of wiring (e.g., DC signal and AC power).
- m. Provide a separate terminal for grounding each shielded cable.

- n. Use separate 5/16-inch diameter copper grounding studs for instrument signal cable shields and AC power.
 - o. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
 - p. When DC power and/or low voltage AC power is required, provide and install the necessary power supplies and transformers in the panel.
 - q. Provide circuit breakers to protect each circuit, with no more than six instruments on a single circuit.
 - r. Provide complete wiring diagram showing "as-built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.
4. Surge Protection:
- a. General: Surge protection shall be provided to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. The protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in suitable metallic cases, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate junction box (compatible with the area designation) coupled to the enclosure.
 - b. Provide formal lightning and surge protection devices for all signal lines, data highways, and power interfaces with PLCs at remote sites. For signal lines, data highways, power feeds to control panels and PLC hardware, provide formal lightning and surge protection devices for all lines that originate or are routed outside a building on any part of the existing or proposed circuit, on in either buried or exposed raceways. Provide formal lightning and surge protection for all transmitters installed under this Contract in an outside environment.
 - c. Lightning and surge protection devices shall be standard manufactured products comprising multi-component networks or hybrid circuits. The units shall incorporate gas filled discharge tubes, and zener diodes providing full protection from line to line and from line to ground.
 - d. Units shall be pluggable, din-rail mounted, rated for a 10KA maximum surge current and voltage suitable for the type of circuit being protected. Reaction time shall be in

- the order of nanoseconds. Units shall include local and remote fail indication.
- e. The units shall be as manufactured by Phoenix Contact, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment conformance with NEC
- B. Unless otherwise noted, install indoor NEMA 4X panels on 4-inch concrete pad. Extend pad 4-inches beyond outside dimensions of base, all sides. Lay grout after panel sills have been securely fastened down.
- C. Unless otherwise noted, install outdoor NEMA 4X panels on a reinforced concrete pedestal:
 - 1. Minimum Thickness: Eight-inches with No. 4 steel reinforcing bars at 12-inches on centers, each way.
 - 2. Minimum Size: Twelve-inches larger than outer dimensions of base, all sides.
 - 3. Provide excavation and backfill work in conformance with the specifications.
 - 4. Provide concrete work in conformance with Section 03055, Concrete.
- D. Install anchor bolts and anchor in accordance with Section 01600, General Material & Equipment Requirements.
- E. Install and interconnect all equipment, devices, electrical hardware, instrumentation and controls and process controller components into and out of and among the enclosures as indicated on the Drawings.

3.2 TESTING AND ADJUSTMENTS

- A. Perform system testing and make any adjustments necessary in accordance with this Section and Section 17000, Instrumentation, Control and Monitoring System General Requirements.
- B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment.

END OF SECTION

SECTION 17275

MISCELLANEOUS PANEL INSTRUMENTS AND DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of miscellaneous panel- mounted instruments which form a part of the process control systems specified in Section 17100. Instruments specified in this section are required to provide an interface between the operator and the process. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Related Work Specified Elsewhere:
 - 1. Division 1 General Requirements
 - 2. Section 17000 Instrumentation, Control and Monitoring System – General Requirements
 - 3. Section 17211 Process Taps and Primary Elements.
 - 4. Section 16155, Low Voltage Combination Magnetic Motor Starters
 - 5. Section 16165, Disconnect Switches
 - 6. Section 16175, Instrument Transformer, Meter Switches, and Accessories

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. Drawings, information and technical data for all equipment as required in Section 17100 and this section shall be submitted. All required information for this section shall be included in one complete submittal.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements.
- B. Manufacturer:

Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.

- C. Installer:
Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

PART 2 - PRODUCTS

2.1 POWER SUPPLIES

- A. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.
- B. The 24 VDC power supply shall meet the following requirements:
1. Input power: 115 vac, plus or minus 10 percent, 60 Hz.
 2. Output voltage: 24 vdc.
 3. Output voltage adjustment: 5 percent.
 4. Line regulation: 0.05 percent for 10 V line change.
 5. Load regulation: 0.15 percent no load to full load.
 6. Ripple: 3 mV RMS.
 7. Operating temperature: Full output current between -32 to 140 degrees Fahrenheit.
 8. DIN rail mounting.
 9. Integrated Selective Fused Breaking.
 10. Local and remote fail indication.
- C. Size the 24 vdc power supply to accommodate the design load plus a minimum 30 percent spare capacity. Provide calculation with the submittal.
- D. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
- E. Mount the 24 vdc power supply such that dissipated heat does not adversely affect other panel components.
- F. Provide a Power Supply Diode Redundancy module from the same manufacturer of the power supplies.

G. Products and Manufacturers:

1. Phoenix Contact.
2. Puls.
3. Allen Bradley.
4. Or Equal.

2.2 INTRINSICALLY SAFE RELAY

A. General: Intrinsically Safe Relay shall electrically isolate circuits extending into Class I, Division I (Group A, B, C and D) hazardous areas from circuits in non-rated areas. Failures of the circuit within the hazardous area shall be indicated by illuminating a light emitting diode (LED) located on the face of the relay.

B. Required Features:

1. Contact design: one Normally Open (NO) and one Normally Close (NC), isolated contacts.
2. Contacts Rating: 8A at 110 VAC resistive, 5A at 30VDC resistive
3. Contact Cycle Rating:
 - a. Mechanical 10,000,000 operations.
 - b. Electrical: 100,000 operations minimum at rated load.
4. Electronic Module: Solid state components epoxy encapsulated in nylon shell.
5. Supply Voltage: 115 VAC 50/60Hz.
6. Supply Current: Relays energized, 1.7 VA.
7. Sensitivity: 0-470,000 ohms Maximum specific resistance.
8. Operation Temperature: -40°F to 150°F.
9. Time delay: 0.5 seconds rising level, 3 seconds lowering level.

C. Products and Manufacturers: Provide one of the following:

1. Phoenix Contact.
2. Gems Sensors,
3. Or equal.

2.3 INTRINSICALLY SAFE DC BARRIER

A. General: Intrinsically Safe DC Barrier shall electrically isolate DC circuits extending into Class I, Division I (Group A, B, C and D) hazardous areas from circuits in non-rated areas. Failures of the circuit within the hazardous area shall be indicated by illuminating a light emitting diode (LED) located on the face of the barrier.

B. Required Features:

1. Current Input: 4 to 20 mA.
2. Voltage Input: 0 to 10 VDC
3. Input Resistance: 50 Kohms.

4. Electronic Module: Solid state components epoxy encapsulated in nylon shell.
 5. Supply Voltage: 115 VAC 50/60Hz.
 6. Operation Temperature: -40°F to 150°F.
 7. DIN Rail Mount.
- C. Products and Manufacturers: Provide one of the following:
1. Phoenix Contact.
 2. Gems Sensors,
 3. Or equal.

2.4 UNINTERRUPTIBLE POWER SYSTEM

- A. General:
1. Uninterruptible Power System (UPS) shall be furnished to provide a reliable source of uninterruptible power with no break in AC output power during a complete or partial interruption of incoming line power. UPS shall include audio/visual alarms. UPS shall be UL listed.
- B. Description: On line dual track power conditioner and true (0 ms transfer time) uninterruptible power supply providing isolation, line regulation and conditioning, using sealed 48 VDC maintenance free batteries and switch mode power supply for uninterrupted power with 0.5 to 0.7 power factor and 2.7 to 3.5 crest factor.
- C. Features:
1. Unit shall provide uninterrupted conditioned power, under fully loaded conditions, for minimum of 20 minutes. Unit shall be sized to accommodate power requirements for all equipment it is to power for the required length of time and shall provide ten percent spare output capacity at minimum.
 2. Rating: 1.4KVA/1.0KW minimum.
 3. Lighting and Surge Protection: Inherent 2000: One spike attenuation.
 4. Regulation: One to three percent load regulation with less than 2pF effective coupling capacitance for line to load.
 5. Output Waveform: Computer grade sine wave with three percent maximum single harmonic and five percent maximum total harmonic distortion.
 6. Output Frequency: 60 Hz $\pm$ 0.5 Hz.
 7. Operating Temperature: 1°C to 40°C.
 8. Relative Humidity: Five to 90 percent non-condensing.
 9. Normally Closed contact output for Battery Low and UPS fail alarms to be connected to a DCS discrete input.
 10. Input Protection: Independent battery charger fuse and DC fuses.

11. Output Protection: Inherently current limited ferro-resonant transformer.
12. Battery Charger: Two-step charger, 8 A and 2 A.
13. AC Input: 120VAC, 60Hz, single phase, +15 percent, -20 percent.
14. AC Output: 120VAC, 60Hz, single phase, +3 percent, -3 percent.
15. Provide a DIN rail mount Bypass switch.

D. Products and Manufacturers:

1. Best Power Technology, Ferrups FE Series.
2. American Power Conversion Corp. (APC)
3. Or Equal.

2.5 CONTROL RELAY

A. Type: General purpose, plug-in Ice-cube type rated for continuous duty.

B. Construction Features

1. Coil Voltages: 24 VDC or 120VAC, as required.
2. Contacts: DPTD or 4PDT
 - a. Silver cadmium oxide rated not less than 10 A resistive at 120 VAC or 24 VDC continuous.
 - b. For switching low energy circuits (less than 200 mA) fine silver, gold flashed contacts rated not less than 5 A resistive at 120 VAC or 28 VDC continuous shall be provided
3. Relays to have clear plastic dust cover.
4. Relays to have pilot light to show energized coil.
5. Relays to have push-to-test and manual override.
6. Relays to be UL recognized.

C. Products and Manufacturers:

1. Allen Bradley
2. Square D Company.
3. Or equal.

2.6 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. The PLC system shall include as a minimum a power supply, network connections, I/O cards and CPU as shown and as required to achieve the specified functionality. The system shall be complete with all necessary processors, I/O modules, backplanes, power supplies, terminals, terminal bases, and cables. The plant control system hardware listed herein is provided for CONTRACTOR's convenience and may not include all PLC hardware components that shall be provided.

B. The final system configuration shall utilize the System Manufacturer's standard hardware and software to meet the functional requirements of these Specifications.

- C. All equipment furnished under this Contract shall be provided to meet the functional requirements of these Specifications plus a 20 percent growth in project requirements, (e.g., graphic displays, alarms, additional instrumentation and equipment). All equipment shall be provided under this Contract, such that the entire 20 percent project growth can be implemented into the PLC, without any additional hardware cost to the OWNER.
- D. The PLC shall have the ability to communicate with multiple remote I/O racks, or devices configured with multiple I/O modules. The PLC shall have the ability to support multiple data communications networks in the same chassis
- E. Assembled System:
 - 1. Within the enclosure all I/O racks, processor racks, and power supplies shall be grounded and mounted to meet the manufacturer's specifications
 - 2. Provide a dry contact rated at 2 amperes and 120 volts a-c for remote indication of processor failure.
 - 3. PLCs shall be capable of being programmed and updated where installed.
 - 4. Provide interposing relays for all outputs to motor control centers, solenoids or contactor circuits
 - 5. Provide individual fuses for all analog and digital inputs and all analog outputs. Fuses shall be capable of being inspected without removal of and replaced without disassembly of the terminal block. Blown fuse LED status indicators shall be provided
- F. The PLC shall perform the following functions:
 - 1. All I/O boards shall be capable of being removed without powering down any process controller resource
 - 2. Accept analog input signals (4 to 20 mADC) and dry contact input signals (120 VAC).
 - 3. All analog inputs shall have 16-bit resolution with 0.025 percent accuracy.
 - 4. Output analog signals (4 to 20 mADC) and contact output commands as required to meet interface requirements. Contact outputs shall be dry contacts rated for 120 VAC, 60 Hz, two amp service or 24 VDC
 - 5. Respond to interrogations for data and receive downloaded program changes and operating parameter changes from HMI's or engineering workstation.
 - 6. Errors and/or failures shall be indicated locally by Light Emitting Diode (LED) and reported at the HMI. Multiple-bit errors shall cause immediate processor halt. Error diagnostic tables shall be

user accessible and provide clear and accurate descriptions of PLC system and process level errors.

7. The unit shall be provided with the following timing elements:
 - a. Real-time clock to provide time reference for processor and system operations
 - b. Watchdog timer for monitoring system software operations to detect hardware malfunction or a non-productive loop (stall condition).
8. The processor should be able to perform basic arithmetic operations using floating-point data
9. The processor shall be programmed using ladder logic
10. The process controller, in conjunction with I/O modules, performs all system level operations, system and data table monitoring and maintenance, alarm detection, PID control, user program executions, network request and response handling.
11. The controller shall be able to operate within the following environmental parameters: Processor and I/O modules shall be capable of withstanding temperatures of 32°F to 122°F at a relative humidity of 5 to 95 percent (non-condensing) in system manufacturer's standard enclosures.
12. A single fault tolerant power supply shall be provided for each CPU, rack and I/O modules. Each power supply shall be capable of being powered from separate 120 Vac and 24 or 125 Vdc sources. The power supplies shall incorporate full power factor correction, AC input filtering, and a 40-millisecond hold up time.
13. Isolation transformers and other power normalization devices to protect against over voltage and frequency distortion characteristics shall be used where frequent power failures are common.

G. The PLC shall be Allen Bradley CompactLogix and should have as a minimum the following features and capabilities:

1. The CPU shall be a microprocessor with onboard dynamic random access memory (DRAM) and flash memory for read/write functions and storage of configured data without battery backup. The microprocessor shall operate:
 - a. Minimum of 2.0 Mbytes of User memory
 - b. The controller shall be able to operate within the following environmental parameters: Processor and I/O modules shall be capable of withstanding temperatures of 32°F to 120°F at a relative humidity of 5 to 95 percent (non-condensing) in system manufacturer's standard enclosures.
 - c. Flash memory with minimum 64 Mbytes of memory.
 - d. Product and Manufacturer:
 - 1) 1756-L71, by Allen Bradley
2. Current Input Module:

- a. 4-20 mA DC
 - b. Minimum of 6 isolated input channels.
 - c. Product and Manufacturer
 - 1) 1756-IF61, by Allen-Bradley
- 3. Current Output Module:
 - a. 4-20mA DC
 - b. Minimum of 8 output channels.
 - c. Product and Manufacturer
 - 1) 1756-OF8, by Allen-Bradley
- 4. Discrete Digital Input Module:
 - a. 120VAC voltage monitor
 - b. Minimum of 16 individually isolated input channels.
 - c. Product and Manufacturer.
 - 1) 1756-IA161, by Allen-Bradley
- 5. Discrete Digital Contact Output Module:
 - a. Relay output (NO contacts, 120VAC 2A minimum).
 - b. Minimum of 16 individually isolated output channels.
 - c. Product and Manufacturer:
 - 1) 1756-OW161, by Allen-Bradley
- 6. Ethernet Interface Module:
 - a. Standard Ethernet media (10base2, 10base5, 10baseT, 100baseT, fiber).
 - b. RJ-45 interface.
 - c. Standard TCP/IP communications.
 - d. Subnet masking.
 - e. Provide one module for communication with remote or extended racks.
 - f. Provide one module for communication with the Foxboro DCS.
 - g. Product and Manufacturer:
 - 1) 1756-EN2T, by Allen-Bradley
- 7. Ethernet TAP:
 - a. Shall have two 10/100Mbps copper ports and one 100 Base-FX multi-mode fiber optic port, with LC connector.
 - b. Support linear and device-level ring topologies for Ethernet/IP applications.
 - c. Recovery rate for typical device-level ring less than 3ms.
 - d. Voltage Rating: 24V DC
 - e. Product and Manufacturer:
 - 1) 1783-ETAPxx, by Allen-Bradley.
- 8. I/O Chassis:
 - a. Number of slots as needed.
 - b. Product and Manufacturer:
 - 1) 1756-Ax, by Allen-Bradley.
- 9. Power Supply (PS):
 - a. 120VAC input voltage.

- b. Minimum current output as required to power all local PLC modules.
- c. Product and Manufacturer:
1756-PA, by Allen-Bradley.

2.7 PLC PROGRAMMING SOFTWARE

- A. Software shall support the development of the PLC ladder logic derived from process control strategies as specified herein. Software shall be IEC 1131-3 compliant Ladder Diagram as well as modular, function block type of control elements, which are familiar to control engineers, instrumentation technicians and electricians. The function blocks shall be computational blocks for performing arithmetic, operational blocks for performing such functions as move and convert values, file to file operations, communication blocks for communicating with other PLC's and system resources, special algorithm blocks for advanced control procedures such as shift register, and PID functions. The PID shall use traditional strategies such as proportional, integral derivative (PID) controllers, feed forward, cascaded controllers, etc. shall be provided. Tuning constants shall be easily set from operator consoles. For each analog loop, software to allow provision of status of the manual backup control to be monitored and an alarm generated when switch is not in automatic mode.
- B. For each sequence or logic control loop, a disagreement alarm shall be triggered when a command (start-stop, etc.) is initiated and confirmation is not received.
- C. Supplier shall provide and configure internal diagnostics alarms for the PLC hardware. Alarms shall be suitable to verify proper and to alert operators when alarm conditions occurs. This includes, but is not limited to annunciation blown fuse indication for all I/O, watchdogs for communications failure with any system processor or I/O address, and communications failure with existing third party equipment.
- D. PLC software shall allow for editing of comments and other PLC documentation using traditional editors such as Notepad.
- E. PLC software shall include as easy to use file and printing management module.
- F. The PLC software shall include a report generation module for system information use. The reporting module should allow for user-configured reports.

- G. The PLC software shall use intuitive, menu-driver environment and base package platform. These easy-to-use Graphical User Interface (GUI) packages shall perform configuration and maintenance operations.
- H. The PLC software shall be compatible with Windows 8 professional, 64 bits or latest version.
- I. The PLC software shall be fully compatible with all furnished PLC hardware.
- J. Product and Manufacturer:
 - 1. The City owns a complete licensed software package of RS Studio 5000 Full Edition Version 23.0, RSLinx Professional and RSNetWorx by Rockwell Automation. The supplier shall use its own software and license to configure, test and startup the system.
 - 2. If other PLC, different than Controllogix Series as manufacture by Allen Bradley is provided, Supplier shall provide fully licensed programing software loaded in a configuration computer laptop. Laptop shall have the following minimum features:
 - a. 15" Screen
 - b. Intel core i5, 2.2 GHz processor,
 - c. 6GB DDR3 in RAM memory,
 - d. 750 MB hard drive
 - e. Latest windows operating system
 - f. Optical drive DVD reader.

2.8 FIBER OPTIC PATCH PANELS

- A. Wall-mounted fiber optic patch panels shall accommodate a minimum of 12 individual fibers. Panels shall have a metal enclosure, hinged clear polycarbonate jumper door, jumper routing guides, strain relief points and lockable door. Appropriate quantities of connector modules shall be furnished. The total number of termination points shall not be less than 12.
- B. Provide fiber optic cable patch panels as referenced on the Drawings and which meet the following requirements:
 - 1. Furnished panels with the following accessories:
 - a. Splice trays.
 - b. Cable strain relief
 - c. Bend radius protectors
 - d. Routing guides
 - e. Grommetted cable entries.
 - f. Cable Connectors - Quick-connect, simplex and duplex-type LC couplers with self-centering, axial

alignment mechanisms. Insertion loss not greater than 0.7 dB.

- g. Sufficient working space for removal of connectors
 - h. Identification label.
 - i. All cable management hardware required to accomplish the installation.
- 2. For splice patch panels mounted within control panels, accessories shall be arranged neatly within the panel.
 - 3. Furnish cabinets with internal space to store, organize, and strain relieve incoming and outgoing cables.
 - 4. Provide ground lug for cable support member and routing supports to maintain allowable cable bend radius.
- C. Product and Manufacturers
- 1. Model #OR-615SMFC 12P, by Ortronics.
 - 2. Or approved equal.

2.9 FIBER TERMINAL CONENCTORS

- A. Furnish connectors and components and use specific tools and methods as recommended by the connector manufacturer to form complete and reliable fiber optic cable terminations.
- B. Terminal connector shall be type LC, non-polishing, mechanical splice suitable for 50-micron multi-mode fiber optic cable or single-mode fiber optic cable. Terminal shall be constructed of a composite housing, ceramic ferrule and a fiber stub permanently bonded into the ferrule. The other end of the fiber stub shall be precisely cleaved and ready for splicing
- C. The terminal connector performance characteristics shall be as follows:
- 1. Insertion Loss (Typical) - <0.30 dB.
 - 2. Durability Delta (500 matings) - 0.2 dB.
 - 3. Operating Temperature - -40 to +70 degrees C.
 - 4. Tensile Strength - 22 lbs.
- D. Terminal connectors shall be provided by one of the following manufacturers:
- 1. Corning Cable Systems.
 - 2. Radiant Corporation.
 - 3. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

Install each item in accordance with manufacturers recommendations and in accordance with the Contract Documents.

3.2 TESTING

Comply with the requirements of Section 17000, Instrumentation, Control And Monitoring System General Requirements.

END OF SECTION

SECTION 17940
COMMUNICATION LINKS

PART 1 – GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing all fiber optic and wire communication links to interconnect components of the Distributed Control System (DCS), security (access) system and fire alarm system as shown on the Drawings and as specified herein. See the DCS Block Diagram, drawings for additional communication link requirements, including equipment locations and quantities.
- B. Items provided under this Section are installed in enclosures provided under Section 16100, Basic Materials and Methods.
- C. Related Work Specified Elsewhere:
 - 1. Division 1, General Requirements
 - 2. Section 16121, Instrumentation and Communication Cable.
 - 3. Section 17000, Instrumentation, Control and Monitoring – General Requirements
 - 4. Section 17260, Process Control Panels and Hardware

1.2 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Manufacturer installation recommendations for all products. Provide complete installation procedures that will be followed for this work.
- B. Test procedures prior to testing. Provide test documentation after testing.
- C. Training procedures prior to training.
- D. Catalog cut sheets.

1.3 FINAL DOCUMENTATION

- A. Provide final documentation required by Section 17000.
- B. Provide all test documentation.

1.4 TRAINING

Provide one day of training for City personnel during installation. Provide one day of training for City personnel during post-installation testing.

PART 2 - PRODUCTS

2.1 FIBER OPTIC COMMUNICATION LINKS

A. Fiber Optic Cable:

1. Each cable shall contain a minimum of 18 functional fibers after installation, connection, and testing are complete.
2. Fiber shall be a multimode, graded index, solid glass waveguide, and shall be coated to preserve the intrinsic strength of the glass. Each fiber shall be color coded. Fiber shall have the following characteristics:

Parameter	Characteristic
Core diameter:	62.5 microns
Cladding diameter	125 microns
Refractive index delta	2.0 percent
Numerical aperture (NA)	0.275
Attenuation at 1300 nm	1.0 dB/km maximum
Bandwidth at 1300 nm	500 MHz/km minimum
Attenuation at 850 nm	3.75 dB/km maximum
Bandwidth at 850 nm	160 MHz/km minimum

3. Cable shall include a buffer tube surrounding the fibers, one or more strength members, and an outer jacket. Cable components shall be of continuous material with no factory splices, holes, blisters, or other imperfections. Cable shall have the following characteristics:

Parameter	Characteristic
Material	non-metallic
Tensile load rating	600 lb minimum, long term

Bend radius rating	5 inches maximum unloaded (0-180 lb); 10 inches maximum loaded (181-600lb)
Diameter	0.5 inches nominal

4. Buffer tube shall allow for free fiber movement and thermal expansion. Buffer tube shall be flooded internally with a gel compound to prevent fiber contamination and freezing stress from moisture.
5. Strength members shall protect fibers from mechanical stress during installation and required service.
6. Cable shall be for outdoor installation in conduit.
7. Fiber optic cable shall be Corning Cable Systems, AT&T, or equal.

B. Fiber Optic Connectors:

1. Provide a connector on each end of each fiber.
2. Type: ST (bayonet twist-lock keyed).
3. Typical attenuation: 0.2 dB.
4. Maximum attenuation: 0.4 dB.
5. Loss repeat: less than 0.2 dB per 1,000 reconnects.
6. Fiber optic connector shall be Corning Cable Systems, AT&T, or equal.

C. Fiber Optic Patch Panels:

1. Provide a patch panel at fiber optic cable termination as shown on the Drawings.
2. Patch panel shall include coupling panel(s), bayonet/threaded couplings, and a lockable door. Patch panel shall totally enclose the connectors and patch cords. Provide 19-inch rack mounting brackets.
3. Mount 2 patch panels side-by-side in enclosures provided under Section 17260, Process Control Panels and Hardware as required. Terminate each fiber optic cable at a separate patch panel.
4. Going clockwise around the site, terminate the incoming cable at the left patch panel and the outgoing cable at the right patch panel.

5. Fiber optic patch panel shall be Corning Cable Systems, AT&T, Black Box, or equal.
6. Coupling panel shall be Corning Cable Systems, AT&T, Black Box, or equal.
7. Couplings shall be Corning Cable Systems, AT&T, Black Box, or equal.
8. Mounting bracket shall be Corning Cable Systems, AT&T, Black Box, or equal.

D. Fiber Optic Patch Cords:

1. Provide patch cords to interconnect two cable fibers between panels (pass through jumper) or to connect cable fibers to converters as indicated on the Block Diagram. Each patch cord shall have 2 fibers for 2 direction communication.
2. Patch cord fibers shall be 62.5-micron with associated attenuation and bandwidth parameters as specified. Each fiber shall have an individual thermoplastic tight buffer tube, strength member, and a thermoplastic jacket.
3. Provide a minimum of 20 percent spare or 2 spare patch cords, whichever is greater, of each type and length.
4. Fiber optic patch cords shall be Corning Cable Systems, AT&T, or equal..

E. Fiber Optic Splice Enclosures:

1. Fibers shall not be spliced except where specifically approved in writing by the Engineer. The following shall not be acceptable reasons for splicing fibers: cable length availability or cost; cable installation convenience or cost.
2. If used, splice enclosures shall protect spliced fibers from moisture, soil, strain, or other damage. At each splicing location, sufficient cable length shall be provided to properly rack and splice the cables and to allow for additional future splices.
3. Ground splice enclosures to earth per Division 16, Electrical.
4. Fiber optic splice enclosure shall be Corning Cable Systems, AT&T, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Provide all equipment, instrumentation, and supplies necessary for installation.
2. Remove wire from existing wireways as required.
3. Install fiber optic communication links to ensure a minimum number of splices. Fiber splices shall be made only with written approval from the Engineer prior to implementation. Wire conductors shall not be spliced.
4. Provide a minimum of 5 feet spare cable (fiber optic and wire) coiled at each cable access point (manholes, handholes, and trenches).
5. Provide cable supports in manholes and handholes according to requirements in Division 16, Electrical. Existing cable supports may be used where available and not damaged.
6. Tag all cables, fibers, and conductors according to Division 16, Electrical, Section 16195, Identification for Electrical Systems. Provide tag documentation.
7. Pull a 200-pound tensile strength polyolefin cord through each conduit where cable is pulled.
8. Install all cable according to manufacturer recommendations. Pull all cable through conduit at the same time. Do not exceed the manufacturer recommended pulling tension. See Section 16195, Identification for Electrical Systems for additional requirements.

B. Fiber Optics:

1. Demonstrate to the Engineer that manufacturer installation recommendations are strictly followed for all fiber optic components.
2. Fiber optic cable fibers shall be "fanned out" and each individual fiber shall be sleeved over with a kevlar reinforced furcation tube. At the convergence point of all furcation tubes, provide fiber strain relief with a fan-out collar. Provide fiber strain relief at each connector. Provide cable gel blocking. Provide dust caps on each fiber connector until final assembly. Provide dust caps on each connector that is not coupled.

3. Attenuation for a single fiber optic connection point (connector through coupling through connector) shall be 0.7 dB maximum.
4. Where fiber optic splices are necessary and approved, fibers shall be fusion spliced. Attenuation for a single splice shall be 0.2 dB maximum. Test each splice with an Optical Time Domain Reflectometer (OTDR) bi-directionally to verify compliance at the time of splicing. Splices not conforming to these specifications shall be redone to meet specifications. Provide cable moisture protection during splicing operations.
5. Attenuation for each fiber optic link shall be 13 dB maximum, as required for a minimum gain margin of 4 dB. The gain margin is the decibel difference between the gain of the fiber optic converters (17 dB) and the loss budget of the fiber optic link (fiber optic cables, connectors, patch cords, and splices).

3.2 TESTING

- A. Provide all equipment, instrumentation, and supplies necessary for testing. The Engineer shall have the option to witness and actively participate in the on-site tests.
- B. Fiber Optic Pre-installation Testing:

Prior to installing each cable, provide an Optical Time Domain Reflectometer (OTDR) test for each fiber at 1300 nm wavelength on the shipping spool. The OTDR test shall verify that each fiber meets the manufacturer attenuation specifications and that the cable was not damaged during shipping. Provide hard copy test documentation, including traces. Obtain approval from the Engineer prior to cable installation.

- C. Fiber Optic Post-Installation Testing:
 1. After cables and connectors are installed, OTDR test each fiber in both directions at 1300 nm wavelength. Provide hard copy and diskette test documentation.
 2. After patch cords and couplings are installed, end-to-end attenuation test each fiber between transceiver connectors in both directions at 1300 nm wavelength. Use a stabilized light source and an optical power meter. Provide test documentation, including reference power reading.
 3. Provide test documentation to the DCS supplier including detailed specifications for all cables and connectors used.
- D. Fiber Optic Test Documentation:

Test documentation shall include cable and fiber identification; fiber length; test direction; test wavelength; traces; fiber attenuation; attenuation breakdown for each fiber segment, connector, and coupling; and splice attenuation if applicable.

E. Wire testing:

Test wire per Section 16999, Acceptance Testing and Calibration of Division 16, Electrical.

END OF SECTION