MACON WATER AUTHORITY

CONTRACT FOR

REPLACE 4160v GEAR & MCC
AT
LOWER POPLAR WWTP
BLOWER BUILDING

Designed by

CLARKNEXSEN

March 06, 2025

PROPRIETARY NOTICE

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END OF INDEX

SECTION 00020

INVITATION TO BID

THE MACON WATER AUTHORITY
MACON, GEORGIA

Sealed Bids for furnishing all materials, labor, tools, equipment and appurtenances necessary for the installation of **Replace 4160v Gear & MCC at Lower Poplar WWTP Blower Building** (the "Project") will be received by the Macon Water Authority (the "Owner"), at the Macon Water Authority, 537 Hemlock Street, Human Resources Training Room, Macon, Georgia 31201 until **2:00 P. M., local time, July 24, 2025,** and then at said office publicly opened and read aloud. All bidders must attend a **mandatory pre-bid meeting** at the **Project Site: 1101 Lower Poplar St. Blower Building** at **10:00 A.M. on July 8, 2025**. All bid questions must be submitted to the Owner by **10:00 A.M. on July 15, 2025**. The Bidder should attend the pre-bid meeting in its entirety.

The Project consists of removal and replacement of 4160v switchgear serving blowers. Removal and replacement of motor control center. New electrical equipment to be relocated to adjacent room. Miscellaneous Architectural and Mechanical upgrades to adjacent new electrical space.

The Project will be awarded in one Contract. Fifty-one percent (51%) of the Work under the Contract Documents must be self-performed by the General Contractor. The Project will be awarded by base bid on a lump sum basis for the performance and completion of all Work required by the Contract Documents.

The Contract Documents include, but may not be limited to, the Instructions to Bidders, the Contract Agreement, the General Conditions, the Drawings, the Specifications (Divisions 01 through 46, inclusive, where applicable), and the forms of Bid Bond, Performance Bond, and Payment Bond. These and any other Contract Documents may be examined at the following location:

Engineering Department
Macon Water Authority
537 Hemlock Street
Macon, GA 31201

Copies of Contract Documents may be obtained at ARC Document Solutions, (152 Spring St. Macon, GA 3121, Phone: (478)-746-3331, email: macon.jobs@e-arc.com) upon a **non-refundable** payment of **$150.00** for each set, payable to Clark Nexsen at 3920 Arkwright Rd, Ste. 385, Macon, GA 31210. A street address must be provided to ensure prompt delivery. No partial sets of bidding documents shall be issued. **Bidders must purchase the Contract Documents in order to be eligible to submit a bid.** Bid documents on the MWA website are for informational purposes only.

Each Bid must be accompanied by a Bid Bond in the amount of 10% of the Bid, prepared on the form of Bid Bond that is part of the Contract Documents, duly executed by the Bidder as principal

and having as surety thereon a surety company licensed to do business in the State of Georgia and listed in the latest issue of U.S. Treasury Circular 570.

Bidders must comply with the Disadvantaged Business Enterprise Participation Requirements specified in the Instructions to Bidders.

The Bidder shall affix to the outside of its Bid envelope the Bidder's Georgia Utility Contractor License Number. A license number of a Utility Manager or a subcontractor is insufficient, and any Bid that fails to affix to the outside of its Bid envelope the Bidder's Georgia Utility Contractor License Number may be rejected.

The successful Bidder for this Project shall be required to furnish a Performance Bond and Payment Bond, satisfactory to the Owner, each in the amount of 100 % of the Contract Price.

Employment of Local Businesses and Contractors: It is the desire of the Owner that local businesses--including disadvantaged, minority, and women enterprise subcontractors-- be given the opportunity to participate on the various parts of the Work.

The Owner's encouragement of participation of disadvantaged, minority, and women enterprises and of locally owned businesses and contractors is not intended to restrict or limit competitive bidding or to increase the cost of the Work. The Owner supports a healthy, free market system that seeks to include responsible local businesses and provide ample opportunities for local business growth and development.

In an effort to assist minority-owned businesses, Georgia law permits an income tax adjustment on the state tax return of any company that subcontracts with a certified minority-owned firm to furnish goods, property or services to the State of Georgia pursuant to O.C.G.A. §48-7-38. Suppliers should consult with their tax advisors to find out how to take advantage of these tax credits.

The Owner reserves the right to reject any or all Bids. The Owner reserves the right to waive informalities and technicalities.

The Macon Water Authority
Ron Shipman
Executive Director & President

END OF SECTION

SECTION 00100

INSTRUCTIONS TO BIDDERS

1.01 CONTRACT DOCUMENTS

A. The Bidder's attention is directed to the General Conditions and other Contract Documents, all of which should be reviewed and studied by the Bidders before submitting a Bid.

B. The Contract Documents shall define and describe the complete Work to which they relate.

1.02 DEFINITIONS

The Bidder's attention is called to the definitions set forth in Article 41 of the General Conditions.

1.03 PREPARATION AND EXECUTION OF BID

A. Each Bid must be prepared to represent that it is based solely upon the materials and equipment specified in the Contract Documents.

1. *Trade Names.*— When reference is made in the Contract Documents to trade names, brand names, or to the names of manufacturers, such references are made solely to indicate that products of that description may be furnished and are not intended to restrict competitive bidding. Unless requests for approvals of other products have been received and approvals have been published by addendum in accordance with the procedure described below in this Section, the successful Bidder may furnish no products of any trade names, brand names, or manufacturers' names except those designated in the Contract Documents.
2. *Use of other products.*—If a Bidder desires to use products of trade or brand names or of manufacturers' names which are different from those specified in the Contract Documents, application for the approval of the use of such products must be received by the Engineer at least ten (10) days prior to the date set for the opening of Bids. The application to the Engineer for approval of a proposed product must be accompanied by:
    a. a schedule setting forth in which respects the materials or equipment submitted for consideration differ from the materials or equipment designated in the Contract Documents; and
    b. a copy of the published recommendations of the manufacturer for the installation of the product together with a complete schedule of changes in the drawings and specifications, if any, which must be made in other work in order to permit the use and installation of the proposed product in accordance with the recommendations of the manufacturer of the product.

In addition, the Engineer will give consideration to reports from reputable independent testing laboratories, verified experience records showing the reputation

of the proposed product with previous users, evidence of reputation of the manufacturer for prompt delivery, evidence of reputation of the manufacturer for efficiency in servicing its products, or any other written information that is helpful in the circumstances. To be approved, a proposed product must also meet or exceed all express requirements of the Contract Documents.

3. *Burden of proof.*— The degree of proof required for approval of a proposed product as acceptable for use in place of a named product or products is that amount of proof necessary to convince a reasonable person beyond all doubt.
4. *Request for conference.*—Any Bidder who alleges that rejection of a submittal is the result of bias, prejudice, caprice, or error on the part of the Engineer may request a conference with a representative of the Owner: PROVIDED, that the request for said conference, submitted in writing, shall be received by the Owner at least five (5) days prior to the date set for the opening of Bids, time being of the essence.
5. *Issuance of addenda.*— If the submittal is approved by the Engineer, an addendum will be issued to all prospective Bidders. Issuance of an addendum is a representation to all Bidders that the Engineer, in the exercise of its professional judgment and discretion, established that the product submitted for approval is acceptable and meets or exceeds all express requirements.

B. Each Bid must be submitted on the Bid forms which are a part of the Contract Documents. **All blank spaces for Bid prices, both words and figures, must be filled in and completed in ink.** In case of discrepancy, the amount shown in words will govern. All required enclosed certifications or other documents must be fully completed and executed when submitted.

C. In case of discrepancies between the figures shown in the unit prices and the totals, the unit prices shall apply and the totals shall be corrected to correspond with the unit prices. In case of discrepancies between written amounts and figures, written amounts shall take precedence over figures and the sum of all Bid extensions (of unit prices) plus lump sum items shall take precedence over the Bidders input of the Bid Total.

D. Each Bid must be submitted in a sealed envelope, addressed to the Macon Water Authority (the "Owner"). Each sealed envelope containing a Bid must be plainly marked on the outside as, "**Replace 4160v Gear & MCC at Lower Poplar WWTP Blower Building".**

E. The Bidder shall provide on the outside of the sealed envelope the following information:
   1. Bidder's Name;

2. Bidder's Georgia Utility Contractor License Number (if applicable); and,
3. The words, “SEALED BID”

F. Any Bid submitted which does not contain the above information on the outside of the sealed envelope will not be opened and will be returned to the Bidder.

G. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed as follows:

THE MACON WATER AUTHORITY
Attn: Heather Veal
537 Hemlock Street
Post Office Box 108
Macon, Georgia 31202-0108

H. Any and all Bids not meeting the aforementioned criteria for Bid submittal may be declared non-responsive, and subsequently returned to the Bidder unopened.

I. The Bidder, in signing a Bid on the whole or any portion of the Project, shall conform to the following requirements:

1. Bids which are not signed by individuals making the Bid shall have attached thereto a power of attorney evidencing authority to sign the Bid in the name of the person for whom it is signed.

2. Bids which are signed for a partnership shall be signed by all of the partners or by an attorney-in-fact. If a Bid is signed by an attorney-in-fact, there should be attached to the Bid a power of attorney executed by the partners evidencing authority to sign the Bid.

3. Bids which are signed for a corporation shall have the correct, legal corporate name thereof, as reflected in the records of the Georgia Secretary of State, and the signature of the president or other authorized officer of the corporation manually written below the corporate name following the wording "By _____." The corporate seal shall be affixed to the Bid.

4. The Bidder shall complete, execute and submit the following documents, (if applicable to the Bidder) unwhich are a part of the Contract Documents:

a. The Bid;
b. The Bid Bond;
c. Statement of Bidder's Qualifications;
d. Statement of Equipment;
e. Corporate Certificate, if the Bidder is a corporation;
f. Statement of Disadvantaged Business Enterprise ("DBE") compliance;
g. Contractor's License Certification;
h. Photocopy of State of Georgia Utility Contractor's License;
i. Photocopy of Certificate of Authority from Georgia Secretary of State's Office to do work in Georgia (if out of state contractor);
j. Non-Collusion Affidavit of Prime Bidder;
k. Any and all forms, certifications or other documentation required by the Georgia Department of Natural Resources Environmental Protection Division.

1.04 METHOD OF BIDDING

The unit or lump sum price for each of the several items in the Bid of each Bidder shall include its pro rata share of overhead and profit so that the sum of the products, obtained by multiplying the quantity shown for each item by the unit price, represents the total Bid. Any Bid not conforming to this requirement may be rejected. Additionally, unbalanced Bids (including unbalanced unit prices) may be rejected. Conditional Bids shall not be accepted. ***The special attention of all Bidders is called to this provision, for should conditions make it necessary to revise the quantities, no limit will be fixed for such increased or decreased quantities, nor extra compensation allowed.***

1.05 ADDENDA AND INTERPRETATIONS

A. No interpretation of the meaning of the Drawings, Specifications or other pre-bid documents or Contract Documents shall be made to any Bidder orally.

B. Any and all such interpretations and any supplemental instructions will be in the form of written Addenda to the Contract Documents which, if issued, will be mailed, shipped or faxed to all prospective Bidders (at the respective addresses furnished) at least seventy-two (72) hours (exclusive of weekends and holidays) prior to the date fixed for the opening of Bids.

C. Failure of Bidders to receive or acknowledge any Addendum shall not relieve them of any obligation under the Bid or the Contract Documents. All Addenda shall become part of the Contract Documents and obligations there under binding.

1.06 BID MODIFICATIONS

Bidders may modify their Bid by facsimile communication at any time prior to the scheduled closing time for receipt of Bids, provided such facsimile communication is received by the Owner prior to the time Bids are required, and provided further that the Owner is satisfied that a written confirmation of the facsimile modification over the signature of the Bidder was mailed by the Bidder to the Owner prior to the time Bids are required. The facsimile communication should not reveal the Bid price but should provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed Bid is opened. If written confirmation from the Bidder is not received by the Owner within two business days from the time Bids are required, no consideration will be given to the facsimile modification and the facsimile modification shall be rejected.

1.07 BID SECURITY

A. Each Bid must be accompanied by a Bid Bond, prepared on the form of Bid Bond included herein, duly executed by the Bidder as principal and having as surety thereon

a surety company authorized to do business in the State of Georgia and listed in the latest issue of U.S. Treasury Circular 570, in the amount of **ten (10%)** percent of the Bid. Attorneys-in-fact who sign Bonds must file with each Bond a currently dated and valid original of their power of attorney. Where validity and currentness of a power of attorney are established by certification executed by a corporate officer, the certification shall be made and executed by a corporate officer of record, as reflected in the records of the Georgia Secretary of State, or by valid corporate resolution or authorization identifying such corporate officer.

B. Except as provided in O.C.G.A. §§ 36-91-52 and 36-91-53, if for any reason whatsoever the successful Bidder withdraws from the competition after opening of the Bids, or if Bidder refuses to execute and deliver the Contract and Bonds required in Article 2 of the General Conditions, the provisions of the Bid Bond may be enforced.

C. Except as provided in O.C.G.A. §§ 36-91-52 and 36-91-53, a Bid may not be revoked or withdrawn until sixty (60) days after the time set for opening the Bids. Upon expiration of this time period, the Bid will cease to be valid, unless the Bidder provides written notice to the Owner prior to the scheduled expiration date that the Bid will be extended for a time period specified by the Owner.

1.08 RECEIPT AND OPENING OF BIDS

The Owner may consider a technicality and informality any Bid not prepared and submitted in strict accordance with the provisions hereof and may waive any technicality and informality or reject any and all Bids. Any Bid may be withdrawn prior to the above scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be opened.

1.09 CONDITIONS OF THE PROJECT

A. Each Bidder must be informed fully of the conditions relating to the construction of the Project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of the obligation to furnish all material and labor necessary to carry out the provisions of the Contract Documents. Insofar as possible, the Bidder, in carrying out the Work, must employ such methods or means as will not cause any interruption of or interference with the work of any other contractor.

B. The Bidder is advised to examine the location of the Project and to be informed fully as to its conditions; access requirements, the conformation of the ground; the character, quality and quantity of the products needed preliminary to and during the prosecution of the work; the general and local conditions and all other matters which can in any way affect the work to be done under the Contract Documents. Failure to examine the site will not relieve the successful Bidder of an obligation to furnish all products and labor necessary to carry out the provisions of the Contract Documents.

C. The Bidder shall notify the Owner of the date and time Bidder proposes to examine the

location of the Project. The Bidder shall confine examination to the specific areas designated for the proposed construction, including easements and public right-of-ways. If, due to some unforeseen reason, the proceedings for obtaining the proposed construction site (including easements), have not been completed, the Bidder may enter the site only with the express consent of the property owner. The Bidder is solely responsible for any damages caused by examination of the site.

D. All anticipated federal, state and local permits required for the Project have not been obtained. Required permits are anticipated on or before _____.

E. All rights of way and easements anticipated for the Project have not been obtained. Required rights of way or easements are anticipated on or before _____.

1.10 EQUAL EMPLOYMENT OPPORTUNITY

A. During the performance of the Contract, the Bidder agrees as follows:

1. The Bidder shall not discriminate against any employee or applicant for employment, or in any employment action during employment, based upon any applicable, legally-recognized and protected basis, including, but not limited to, veteran status, uniformed service member status, race, color, religion, sex, sexual orientation, gender identity, age (40 and over), pregnancy (including childbirth, lactation and related medical conditions), national origin or ancestry, citizenship status, physical or mental disability, genetic information (including testing and characteristics), or any other consideration protected by federal, state, or local law.

2. The Bidder shall, in all solicitation or advertisement for employees placed by or on behalf of Bidder, state that all qualified applicants will receive consideration for employment without regard to any applicable, legally-recognized and protected consideration, including, but not limited to veteran status, uniformed service member status, race, color, religion, sex, sexual orientation, gender identity, age (40 and over), pregnancy (including childbirth, lactation and related medical conditions), national origin or ancestry, citizenship status, physical or mental disability, genetic information (including testing and characteristics), or any other characteristic or basis protected by federal, state, or local law.

3. The Bidder shall send to each labor union or representative of the workers, with which the Bidder has a collective bargaining agreement or other contract or understanding, a notice advising the labor union or worker's representative of the Bidder's commitments under the Equal Employment Opportunity Program of the Owner and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

4. The Bidder and its subcontractors, if any, shall file compliance reports at reasonable times and intervals with the Owner in the form and to the extent prescribed by the Owner or the Georgia Department of Natural Resources.

Compliance reports filed at such times as directed shall contain information as to the employment practices, policies, programs and statistics of the Bidder and its subcontractors.

5. The Bidder shall demonstrate by the documentation required in Paragraph C, below, that a "Good Faith Effort" has been made to achieve compliance with the Owner's goal that a minimum of ten percent (10%) of the Contract Price shall be subcontracted to a Disadvantaged Business Enterprise (DBE), which includes *business enterprises owned by women and by minorities*. More specifically, as used herein, the term "DBE" means a firm or business which is at least fifty-one percent (51%) owned, operated, capitalized, and controlled by one or more United States citizens or lawfully admitted residents who are socially and economically disadvantaged, as defined below.

   As used herein, social disadvantage means an individual who is a member of a *presumed group* or who is a *woman*. Economic disadvantage, as used herein, means, generally, a socially disadvantaged individual who does not have a personal net worth in excess of $1.32 million dollars, excluding the primary residence and ownership in the subject firm.

   Member(s) of a *presumed group* include Black Americans (any Black racial group originating in Africa); Hispanic Americans (origins in Mexico, Puerto Rico, Cuba, Central and South America, or other Spanish or Portuguese cultures); Native Americans (Native of Alaska or Hawaii or certified member of a federal or state recognized Tribe); Asian Pacific Americans (origins in the Pacific Islands, China, Taiwan, Korea, Japan, Thailand, Burma, Cambodia, Vietnam, Malaysia, Indonesia, Singapore, or Philippines); and Subcontinent Asian Americans (origins in India, Pakistan, Bangladesh, Bhutan, Maldives Islands, Nepal, or Sri Lanka).

   As used herein, the term "subcontracted" means providing subcontracting services or furnishing products or materials to be utilized in the performance of the Work.

6. The Bidder shall include the provisions of paragraphs 1 through 6 of this Section 1.10.A in every subcontract or purchase order so that such provisions will be binding upon each subcontractor or vendor.

B. In determining whether a Bidder has made "Good Faith Efforts", the Owner will look not only at the different kinds of effort that a Bidder has made, but also the quantity and intensity of these efforts.

C. The following list of kinds of efforts is provided for consideration, but this is not an exhaustive list of efforts that may be considered by the Owner:

1. Whether the Bidder attended any pre-solicitation or pre-bid meetings that were scheduled by the Agent to inform DBEs of contracting and subcontracting opportunities;

2. Whether the Bidder advertised in general circulation, trade association, and minority-focus media concerning the sub-contracting opportunities;

3. Whether the Bidder provided written notice to a reasonable number of specific DBEs that their interest in the Contract was being solicited, in sufficient time to allow the DBEs to participate effectively;

4. Whether the Bidder followed up initial solicitations of interest by contacting DBEs to determine with certainty whether the DBEs were interested;

5. Whether the Bidder selected portions of the Work to be performed by DBEs in order to increase the likelihood of meeting the DBE goals (including, where appropriate, breaking down contracts into economically feasible units to facilitate DBE participation);

6. Whether the Bidder provided interested DBEs with adequate information about the Drawings, Specifications and requirements of the Contract Documents;

7. Whether the Bidder negotiated in good faith with interested DBEs, not rejecting DBEs as unqualified without sound reasons based on a thorough investigation of their capabilities;

8. Whether the Bidder made efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance required by the Contract Documents or Contractor; and

9. Whether the Bidder effectively used the services of available minority or women community organizations; minority or women contractor's groups; local, state and federal minority or women business assistance offices and other organizations that provide assistance in the recruitment and placement of DBEs.

D. Each Bidder shall include with his or her Bid a Statement of Disadvantaged Firm Utilization. Such statement shall include, as a minimum, the names and addresses of all disadvantaged/minority/women enterprise firms providing subcontracting services, furnishing products or materials, etc., the nature of the work to be contracted; and the anticipated cost of the services by each named firm as a percentage of the total Contract Price set forth in the Bid. The percentage participation should be calculated on the basis of the proportion of total dollar value of the Bid, including bulk purchase materials supplied by DBEs.

E. It is the desire of the Owner that DBEs be given the opportunity to bid on the various parts of the Work, and that to the extent feasible, DBE firms in the Middle Georgia area will be solicited and used in order to meet the DBE goal set forth above. However, this desire is not intended to restrict or limit competitive bidding or to increase the cost of the Work. The Owner supports a healthy, free market system that seeks to include

responsible businesses and provide ample opportunities for business growth and development.

In an effort to assist minority-owned businesses, Georgia law permits an income tax adjustment on the state tax return of any company that subcontracts with a certified minority-owned firm to furnish goods, property or services to the State of Georgia pursuant to O.C.G.A. §48-7-38. Suppliers should consult with their tax advisors to find out how to take advantage of these tax credits.

1.11 NOTICE OF SPECIAL CONDITIONS

If any special federal, state, county or city laws, municipal ordinances, and the rules and regulations of any authorities having jurisdiction over construction of the Project, enclosed, herein referred to, or applicable by law to the Project, conflict with requirements of the Contract Documents, then the federal, state, county or city laws, municipal ordinances, and the rules and regulations of any authorities having jurisdiction over construction of the Project shall prevail and supersede the conflicting requirements of the Contract Documents.

1.12 OBLIGATION OF BIDDER

A. By submission of a Bid, each Bidder warrants that Bidder has inspected the site and has read and is thoroughly familiar with the Contract Documents (including all addenda). The failure or omission of any Bidder to examine any form, instrument or document shall in no way relieve any Bidder from any obligation in respect to the Bid.

B. Special attention is directed to Article 4, “Insurance” contained at pages 00700-3 through 00700-6 in the General Conditions. The Owner requires (1) “Worker’s Compensation and Employer’s Liability Insurance,” (2) “Commercial General and Umbrella Liability Insurance,” (3) “Business Auto and Umbrella Liability Insurance,” and (4) “Materials and Floater” Insurance. For each of the required policies, the Owner requires a certificate of insurance at least quarterly, a copy of the endorsement of the insurance company showing the Owner as an additional insured, and a copy of the insurance policy declaration and any necessary endorsements.

C. Attention is further directed to Paragraph 6 of 00500, Contract Agreement and Article 9 of 00700, General Conditions regarding assignments. Prior written consent of the Owner is required for any assignment of any portion of this Contract, including any assignment due to “buyout” of Bidder or other acquisition of Bidder where the Bidder is a corporation or where Bidder is 50 percent or more owned by a corporation, firm, or person.

1.13 METHOD OF AWARD

A. The Contract, if awarded, will be awarded to the lowest responsible and responsive Bidder whose Bid meets the requirements and criteria set forth in the Contract Documents. The Contract, if awarded, will be awarded by base bid on a lump sum

basis, comprised of unit prices, for the performance and completion of all Work required by the Contract Documents.

B. The Bidder to whom the award is made will be notified. The Owner reserves the right to reject any and all Bids and to waive any technicalities and informalities in Bids received whenever such rejection or waiver is in the Owner's interest.

C. A responsive Bidder shall be one who submits a Bid in the proper form without qualification or intent other than as called for in the Contract Documents, and who binds itself on behalf of the Bid to the Owner with the proper Bid Bond completed and attached, and who properly completes all forms required to be completed and submitted at the time of the Bidding. The Bidder shall furnish all data, documents, forms, and certifications required by the Contract Documents. Failure to do so may result in the Bid being declared non-responsive.

D. A responsible Bidder shall be one who can fulfill the following requirements:

1. The Bidder shall maintain a permanent place of business. This requirement applies to the Bidder where the Bidder is a division of a corporation, or where the Bidder is 50 percent or more owned by a person, corporation or firm.

2. The Bidder shall demonstrate adequate construction experience and sufficient equipment resources to properly perform the work under and in conformance with the Contract Documents. This evaluation will be based upon a list of completed or active projects and a list of construction equipment available to the Bidder to perform the work. The Owner may make such investigations as deemed necessary to determine the ability of the Bidder to perform the Work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may reasonably request. The Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract Documents and to complete the Project contemplated therein.

3. The Bidder shall demonstrate financial resources of sufficient strength to meet the obligations incident to the performance of the Work covered by the Contract Documents. The ability to obtain the required Performance and Payment Bonds will not alone demonstrate adequate financial capability.

1.14 EMPLOYMENT OF LOCAL LABOR

Preference in employment on the Project shall, insofar as practical, be given to qualified local labor.

END OF SECTION

FEDERAL WORK AUTHORIZATION PROGRAM AFFIDAVITS

EACH BIDDER MUST PROVIDE THE OWNER WITH THE PROPERLY COMPLETED AND PROPERLY SIGNED FEDERAL WORK AUTHORIZATION PROGRAM AFFIDAVITS AS REQUIRED BY O.C.G.A. § 13-10-91

THIS FORM MUST BE COMPLETED BY ALL CONTRACTORS, ALL SUBCONTRACTORS AND ALL SUB-SUBCONTRACTORS

THE FORMS ARE ATTACHED HERETO.

Contractor Affidavit under O.C.G.A. § 13-10-91(b)(1)

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services on behalf of the Macon Water Authority has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned contractor will continue to use the federal work authorization program throughout the contract period and the undersigned contractor will contract for the physical performance of services in satisfaction of such contract only with subcontractors who present an affidavit to the contractor with the information required by O.C.G.A. § 13-10-91(b). Contractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

_____
Federal Work Authorization User Identification Number

_____
Date of Authorization

_____
Name of Contractor

_____
Name of Project

Name of Public Employer: the Macon Water Authority

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, ___, 20___ in _____ (city), _____ (state).

_____
Signature of Authorized Officer or Agent

_____
Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, 20___.

_____
NOTARY PUBLIC

My Commission Expires: _____, 20___.

Subcontractor Affidavit under O.C.G.A. § 13-10-91(b)(3)

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract with _____ _____ [insert name of contractor] on behalf of the Macon Water Authority has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned subcontractor will continue to use the federal work authorization program throughout the contract period and the undersigned subcontractor will contract for the physical performance of services in satisfaction of such contract only with sub-subcontractors who present an affidavit to the subcontractor with the information required by O.C.G.A. § 13-10-91(b). Additionally, the undersigned subcontractor will forward notice of the receipt of an affidavit from a sub-subcontractor to the contractor within five business days of receipt. If the undersigned subcontractor receives notice that a sub-subcontractor has received an affidavit from any other contracted sub-subcontractor, the undersigned subcontractor must forward, within five business days of receipt, a copy of the notice to the contractor. Subcontractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

_____
Federal Work Authorization User Identification Number

_____
Date of Authorization

_____
Name of Subcontractor

_____
Name of Project

Name of Public Employer: Macon Water Authority

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, ___, 20___ in _____ (city), _____ (state).

_____
Signature of Authorized Officer or Agent

_____
Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, 20____.

_____
NOTARY PUBLIC

My Commission Expires: _____, 20____.

Sub-subcontractor Affidavit under O.C.G.A. § 13-10-91(b)(4)

By executing this affidavit, the undersigned sub-subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract for _____ [insert name of subcontractor or sub-subcontractor with whom such sub-subcontractor has privity of contract] and _____ [insert name of contractor] on behalf of the Macon Water Authority has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned sub-subcontractor will continue to use the federal work authorization program throughout the contract period and the undersigned sub-subcontractor will contract for the physical performance of services in satisfaction of such contract only with sub-subcontractors who present an affidavit to the sub-subcontractor with the information required by O.C.G.A. § 13-10-91(b). The undersigned sub-subcontractor shall submit, at the time of such contract, this affidavit to _____ [insert name of subcontractor or sub-subcontractor with whom such sub-subcontractor has privity of contract]. Additionally, the undersigned sub-subcontractor will forward notice of the receipt of any affidavit from a sub-subcontractor to _____ [insert name of subcontractor or sub-subcontractor with whom such sub-subcontractor has privity of contract]. Sub-subcontractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

_____
Federal Work Authorization User Identification Number

_____
Date of Authorization

_____
Name of Sub-subcontractor

_____
Name of Project

_____
Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, ___, 20___ in _____ (city), _____ (state).

_____
Signature of Authorized Officer or Agent

_____
Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, 20___.

_____
NOTARY PUBLIC

My Commission Expires: _____, 20___.

SECTION 00300

BID

TO: MACON WATER AUTHORITY

FROM:_____
(Bidder's Name)

FOR: Replace 4160v Gear & MCC at Lower Poplar WWTP Blower Building

Submitted: _____, 20__

The undersigned Bidder, in compliance with your Invitation to Bid for the construction of this Project, having examined the Contract Documents and the site of the proposed Work, and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of materials and labor, hereby proposes to construct the Project in accordance with the Contract Documents.

The Bidder proposes and agrees, if this Bid is accepted, to contract with the Macon Water Authority, in the form of Contract Agreement specified, and to furnish all necessary products, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of the Work in full and complete accordance with the reasonably intended requirements of the Contract Documents to the full and entire satisfaction of the Macon Water Authority with a definite understanding that no money will be allowed for extra work except as set forth in the Contract Documents, for the following prices:

Item No.	Quantity	Unit	Description	Unit Price	Total Price
1	**BASE BID**				
a.	1	LS	a. Electrical b. Mechanical c. Controls d. Interiors e. General Contractor f. 10% Contingency		
	TOTAL BID:				

Total Bid for Item 1 is inclusive, in the amount of

_____ Dollars

($_____) which sum hereinafter is called the "Base Bid".

The Bidder agrees hereby to commence Work under this Contract, with adequate personnel and equipment, on a date to be specified in a written order of the Engineer, and to fully complete all Work under this Contract within (120) consecutive calendar days from and including said date specified in the written order of the Engineer. Bidder further agrees to pay as liquidated damages, the sum of $250.00 for each calendar day thereafter required to achieve substantial completion of all Work.

The Bidder declares an understanding that the quantities shown for unit price items are subject to either increase or decrease, and that should the quantities of any of the items of Work be increased, the Bidder proposes to do the additional Work at the unit prices stated herein; and should the quantities be decreased, the Bidder also understands that payment will be made on the basis of actual quantities at the unit price bid and will make no claim for additional costs or anticipated profits for any decrease in quantities; and that actual quantities will be determined upon completion of Work, at which time adjustment will be made to the Contract Price by direct increase or decrease.

In case of discrepancies between the figures shown in the unit prices and the totals, the unit prices shall apply and the totals shall be corrected to agree with the unit prices. In case of discrepancies between written amounts and figures, written amounts shall take precedence over figures and the sum of all Bid extensions (of unit prices) plus lump sum items shall take precedence over the Bidder's represented BID TOTAL.

The Bidder furthermore agrees that, in the case of a failure to execute the Contract Agreement and Bonds within ten days after receipt of conformed Contract Documents for execution, the attached Bid

Bond accompanying this Bid and the monies payable thereon shall be paid into the funds of the Macon Water Authority as liquidated damages for such failure.

Attached hereto is a Bid Bond for the sum of _____

_____ Dollars ($_____) according to the conditions of "Instructions to Bidders" and provisions thereof.

Bidder acknowledges receipt of the Following Addenda:

Addendum No. 1, dated:_____

Addendum No. 2, dated:_____

Addendum No. 3, dated:_____

Addendum No. 4, dated:_____

Remainder of Page Left Blank
[Signatures, attestations, and seal on following page]

BIDDER: _____

By: _____

Name: _____
(Print or Type)

Title: _____

Address: _____

_____

Phone: _____

Attest: _____

Name: _____
(Print or Type)

Title: _____

(SEAL)

Note: Attest for a corporation must be by the secretary of record for the corporation, as reflected in the records of the Georgia Secretary of State; for a partnership by another partner; for an individual by a notary.

Note: If the Bidder is a corporation, the Bid shall be signed by an officer of the corporation; if a partnership, it shall be signed by a partner. If signed by others, authority for signature shall be attached.

The full names and addresses of persons or parties interested in the foregoing Bid, as principals, are as follows:

Name	Address

END OF SECTION

SECTION 00410

BID BOND

STATE OF GEORGIA

COUNTY OF MACON-BIBB

KNOW ALL MEN BY THESE PRESENTS, that we, _____, as Principal, and _____, as Surety, are held and firmly bound unto the Owner, the Macon Water Authority, in the sum of _____ Dollars ($_____) lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted to the Owner a Bid for the _____.

NOW THEREFORE, the conditions of this obligation are such that if the Bid be accepted, the Principal shall, within ten days after receipt of conformed Contract Documents, execute a Contract in accordance with the Bid upon the terms, conditions and prices set forth therein, and in the form and manner required by the Contract Documents and execute sufficient and satisfactory separate Performance and Payment Bonds payable to the Owner, each in an amount of 100 percent of the total Contract Price, in form satisfactory to the Owner , then this obligation shall be void; otherwise, it shall be and remain in full force and effect in law; and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid Owner, upon demand, the amount hereof in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

This bond is given pursuant to and in accordance with the provisions of the Georgia Procurement Manual and Georgia Local Government Public Works Construction Law, O.C.G.A. § 36-91-1 et. seq.. All the provisions of the law referring to this character of bond as set forth in said Manual or Code Sections or as may be hereinafter enacted and these are hereby made a part hereof to the same extent as if set out herein in full.

Remainder of Page Left Blank
[Signatures, attestations, and seals on following page]

IN WITNESS WHEREOF, the said Principal has hereunder affixed its signature and seal, and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this _____ day of _____, 20___.

CONTRACTOR - PRINCIPAL: _____

By: _____

Name: _____
(Print or Type)

Address: _____

_____

Phone: _____

Attest: _____

Name: _____
(Print or Type)

Title: _____

(SEAL)

Note: Attest for a corporation must be by the secretary of record for the corporation, as reflected in the records of the Georgia Secretary of State; for a partnership by another partner; for an individual by a notary.

SURETY: _____

By: _____

Name: _____
(Print or Type)

Title: _____

Phone: _____

Attest: _____

Name: _____
(Print or Type)

Title: _____

(SEAL)

Note: Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is

located.

END OF SECTION

SECTION 00420

STATEMENT OF BIDDER'S QUALIFICATIONS

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information desired. Attach all additional sheets to this statement.

1. Name of Bidder:_____

2. Permanent main office address:_____

3. When organized:_____

4. If a Corporation, where incorporated:_____

5. How many years have you been engaged in the contracting business under your present firm or trade name?_____

6. Contracts on hand: (Schedule these, showing amount of each contract and the appropriate anticipated dates of completion):_____

7. General description of type of work performed by your company:_____
_____

8. Have you ever failed to complete any work awarded to you? If so, where and why?
_____

9. Have you ever defaulted on a contract? If so, where and why?
_____

10. Attach a list of the most important projects recently completed by your company which are similar in scope to this Project. For each project, list its: official name and owner, a contact person's name, company and position, address and phone number; completion date; and contract amount.

11. Names, background and experience of the principal members of your organization, including officers:_____
_____

12. The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications.

Dated this _____ day of _____, 20___.

BIDDER:_____

By:_____

Title:_____

State of _____

County of _____

_____ being duly sworn deposes and says that he or she is _____ of _____and that the answers to the foregoing questions and all statements therein contained are true and correct. Subscribed and sworn to before me this _____ day of _____, 20___.

Notary Public:_____

(SEAL)

My Commission Expires:_____
(Date)

END OF SECTION

SECTION 00421

STATEMENT OF EQUIPMENT

Show machinery and other equipment available to the Bidder for prosecuting the Work required by the Contract Documents. (To be filled in by Bidder and submitted with Bid.)

Available Machinery and Other Equipment Kind - Size - Capacity	Location	Ownership	Date Proposed To Be Placed On Work

The above is a true statement of the equipment available to the undersigned Bidder for prosecuting the Work required by the Contract Documents. Where it is shown that the equipment is not owned by the Bidder, arrangements have been made with the owners to furnish the equipment.

Signed:_____

Name:_____

Title:_____

END OF SECTION

SECTION 00422

CORPORATE CERTIFICATE

I, _____, certify that I am the Secretary of the Corporation named as Bidder in the foregoing Bid; that _____, who signed said Bid on behalf of the Bidder was then _____ of said Corporation; that said Bid was duly signed for and on behalf of said Corporation by authority of its Board of Directors, and is within the scope of its corporate powers; that said Corporation is organized under the laws of the State of _____.

This _____ day of _____, 20___.

(Corporate Secretary) _____

(SEAL)

END OF SECTION

SECTION 00423

STATEMENT OF DISADVANTAGED FIRM UTILIZATION

The Bidder shall list all disadvantaged firms, as are defined in the Instructions to Bidders, providing subcontracting services, furnishing products or materials, etc., to be utilized in the performance of the work. This list shall be submitted in the following format:

Subcontractor (Name & Address)	Nature of Work to be Contracted	Group (Local, DBE)	Anticipated Cost of Services ($ Value, %)
			$
			%
			$
			%
			$
			%
			$
			%
			$
			%
			$
			%
			$
			%
			$
			%

NOTE: Any proposed changes from the above list shall be submitted in writing to the Macon Water Authority prior to initiation of the action, with the reason for the proposed deviation.

END OF SECTION

SECTION 00425

CONTRACTOR'S LICENSE CERTIFICATION

Contractor's Name:_____

Georgia Contractor's License Number:_____

Expiration Date of License:_____

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:_____

Printed:_____

Date:_____

END OF SECTION

CONTRACTOR'S CERTIFICATION OF AUTHORITY

(IF OUT OF STATE CONTRACTOR)

Contractor's Name:_____

Georgia Certificate of Authority Number:_____

Expiration Date of Certificate:_____

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:_____

Printed:_____

Date:_____

END OF SECTION

SECTION 00480

NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

STATE OF GEORGIA COUNTY OF BIBB

_____, being first duly sworn, deposes and says that:

He or she is _____

(Owner, Partner, Officer, Representative or Agent)

of _____, the Bidder that has submitted the attached Bid;

He or she is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

He or she understands that collusive bidding is a violation of State and Federal law and can result in fines, prison sentences, and civil damages awards;

Such Bid is genuine and is not a collusive or sham Bid;

Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this Affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the Owner, the Macon Water Authority, or any person interested in the proposed Contract; and

The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this Affiant. Affiant agrees to abide by all conditions of this Bid, and certifies that he or she is authorized to sign this Bid for the Bidder.

(Signed) _____

(Title) _____

Subscribed and Sworn to before me this _____ day of _____, 20___.

_____ My Commission Expires:_____

(Notary Public)
(SEAL)

Note: If the Bidder is a partnership, all of the partners and any officer, agent or other person who may have represented or acted for the partnership shall also make the foregoing oath. If the Bidder is a corporation, all officers, agents, or other persons who may have acted for or represented the corporation shall also make the oath.

END OF SECTION

SECTION 00500

CONTRACT AGREEMENT

AGREEMENT BETWEEN CONTRACTOR AND OWNER

THIS AGREEMENT is made and entered into on the __ day of_____ in the year Two Thousand and _____ (20___) by and between _____, hereinafter
referred to as the "Contractor", and THE MACON WATER AUTHORITY, hereinafter (the "Owner") (collectively, "the Parties").

WITNESSETH, that the Contractor and the Owner, for the consideration hereinafter named, agree as follows:

1. SCOPE OF WORK. - That the Contractor will furnish all products, tools, construction equipment, materials, skill and labor of every description necessary to carry out and to complete in a good, firm, substantial workmanlike manner perform the _____ project and will complete the Work in strict conformity with the Drawings and the Specifications (Divisions 01 through 46, inclusive, together with the foregoing Bid made by the Contractor, the Invitation to Bid, Instructions to Bidders, General and Supplementary Conditions, Special Conditions, Performance and Payment Bonds and all Addenda hereto incorporated (if applicable) which form essential parts of this Contract Agreement, as if fully contained herein, the same collectively referred to as the "Contract Documents."

2. TIME OF COMPLETION.-The Contractor shall commence the Work to be performed under this Contract Agreement on a date to be specified in a written Notice to Proceed and shall achieve substantial completion of all Work required by the Contract Documents within (120) consecutive calendar days (the "Contract Time"). Time is of the essence and is an essential element of this Contract, and the Contractor shall pay to the Owner, not as a penalty, but as liquidated damages, the sum of Two Hundred Fifty Dollars ($250.00) for each calendar day for which there is an unexcused delay in achieving substantial completion of the Work within the time limit set forth herein. These liquidated damages are not established as a penalty but are calculated and agreed upon in advance by the Owner and the Contractor due to the uncertainty and impossibility of making a determination as to the actual and consequential damages incurred by the Owner and the general public of Macon-Bibb County, Georgia as a result of the failure on the part of the Contractor to complete the Work on time. Such liquidated damages referred to herein are intended to be and are cumulative and shall be in addition to every other remedy now or hereafter enforceable at law, in equity, by statute, or under the Contract Documents.

3. THE CONTRACT PRICE.-The Owner shall pay to the Contractor for the faithful performance of the Contract Agreement, subject to additions and deductions as provided for in the Contract Documents, in current funds a sum of _____ Dollars ($_____.00) (the "Contract Price") which sum shall also pay for loss or damage arising out of the nature of the Work aforesaid, or from the action of the elements, or from unforeseen obstructions or difficulties encountered in the prosecution of the Work, and for all expenses incurred by, or in

consequence of the Work, its suspension or discontinuance and for well and faithfully completing the Work and the whole thereof, as herein provided, and for replacing defective Work or products for a period of one year after completion.

4. PROGRESS PAYMENTS The Owner shall make progress payments on account of the Contract Price as follows: On or about the 20th day of each month, ninety-five percent (95%) of the value, based on the contract prices, of labor and materials incorporated in the Work and of materials suitably stored at the site thereof up to the twenty-fifth day of the month preceding, as estimated by the Engineer, less the aggregate of previous payments. Application for Payment must be made on the standard Owner's form to be provided by the Owner to the Contractor. No form of collateral in lieu of cash will be acceptable as retainage. At the discretion of the Owner, the retainage of each Subcontractor may be released separately as each Subcontractor completes its work. An application for release of a Subcontractor's retainage shall bear the certificates of the Subcontractor, the Contractor, and the Engineer that the Subcontractor's work has been fully performed and that the sum for which payment is requested is due by the Contractor to the Subcontractor. Checks releasing a Subcontractor's retainage shall be made payable to the Contractor, the Contractor's surety, and the Subcontractor, and shall be mailed to the Contractor's surety. This Article does not create any contractual relationship between the Owner and the Subcontractor or any duty of the Owner to any Subcontractor. Payments pursuant to this Article shall in no way diminish, change, alter or affect the rights of the Owner under the Contract Documents.

5. FINAL PAYMENT.-(a)-Final payment including retainage, shall be due 30 days after the date of notice from the Owner of the final acceptance of the Work, provided that all other requirements of the Contract Documents shall have been met in full. Final payment shall be made by a check payable jointly to the Contractor and surety and shall be mailed to the surety.

(b)-Upon receipt of written notice from the Contractor pursuant to Article 30 of the General Conditions that the Work is ready for final inspection, the Engineer shall promptly make such inspection, and when he/she finds the Work complies with the Contract Documents, and when the Contract shall have been fully performed the Engineer shall promptly issue a final certificate of recommendation to the Owner, over the Engineer's signature, stating that the Work required by the Contract Documents has been completed under the terms and conditions thereof, and that the entire balance of the Contract Price found to be due to the Contractor and noted in said final certificate, is due and payable.

(c)-Before issuance of a final certificate of recommendation, the Contractor shall submit evidence satisfactory to the Engineer that all payrolls, material bills, and all other indebtedness in connection with the Work has been paid in full.

(d)-If full completion of the Work is materially delayed through no fault of the Contractor, and the Engineer so certifies same, the Owner shall, upon certificate of the Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed. Such payment shall be made under the terms and conditions of the General Conditions governing final payment, except that it shall not constitute a waiver of claims.

6. NO ASSIGNMENT.- This Contract and the proceeds of this Contract may not be assigned

nor may the performance thereunder be assigned, except with the prior written consent of the Owner.

7. BONDS. – The Contractor shall furnish both a performance bond and a payment bond and shall pay the premium thereon. The performance bond shall guarantee the full performance of the Contract.

Remainder of Page Left Blank

[Signatures, attestations, and seals on following page]

IN WITNESS WHEREOF, the parties hereto have executed this Contract Agreement under their respective seals on the day and date first above written in six counterparts, each of which shall, without proof or accounting for the other counterparts, be deemed an original Contract.

Signed, sealed, and delivered
in the presence of:

THE MACON WATER AUTHORITY

1._____ By:_____
Gary Bechtel, Chairman

2._____

Attest:_____
Ron Shipman, Executive Director & President

(Official Seal)

Signed, sealed, and delivered
in the presence of:

CONTRACTOR:_____

1._____ By: (Signed) _____

2._____ (Printed) _____

Attest: (Signed) _____

(Printed) _____
(Secretary)

(Corporate Seal)

APPROVED AS TO FORM

_____

_____
(Printed Name)
Attorney for the Macon Water Authority

END OF SECTION

SECTION 00550

PRE-AWARD OATH

STATE OF GEORGIA
COUNTY OF _____

In accordance with O.C.G.A. 36-91-21(e), we, the undersigned of _____

being first duly sworn, depose and say that:

We have not directly or indirectly violated O.C.G.A. 36-91-21(d), and more specifically, we have not

- prevented or attempted to prevent competition in such bidding or proposals by any means whatever,
- prevented or endeavored to prevent anyone from making a bid or proposal thereof by any means whatever, nor
- caused or induced another to withdraw a bid or proposal for the work.

We, the undersigned, to the best of our knowledge, affirm that no other officers, agents or other persons acted for or represented the Contractor in the bidding for and procurement of this Contract.

Signature	Printed Name	Title	Date

_____ My Commission Expires: _____
(Notary Public)

(SEAL)

END OF SECTION

SECTION 00600

PERFORMANCE BOND

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS:

That

_____

(Legal title and address of the Contractor)

as Principal (hereinafter referred to as "Contractor"), and _____

_____

(Legal title and address of Surety)

as Surety (hereinafter referred to as "Surety"), do hereby acknowledge ourselves indebted and firmly bound and held unto the Macon Water Authority (the "Owner") in the amount of _____ Dollars ($_____.00) to which payment Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above bound Principal has entered into a Contract with Owner bearing date of _____ for construction of _____ Project in accordance with Contract Documents prepared by Owner all of which said Contract Documents are incorporated herein by reference and made a part hereof, and are hereinafter collectively referred to as the "Contract."

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Contractor shall promptly and faithfully perform and comply with the terms and conditions of said Contract; and shall indemnify and save harmless the Owner against and from all costs, expenses, damages, injury or loss to which said Owner may be subjected by reason of any wrongdoing, including patent infringement, misconduct, want of care or skill, default or failure of performance on the part of said Principal, his agents, subcontractors of employees, in the execution or performance of said Contract, and shall fully reimburse and repay the said Owner any and all outlay, costs, and expense which it may incur in making good any such default and shall guarantee all products and workmanship against defects, as provided in the Contract Documents which comprise and constitute the Contract, for a period of one year and shall replace all defective work and products for such period of one year then this obligation shall be null and void; otherwise it shall remain in full force and effect.

1. The said Surety to this bond, for value received, hereby stipulates and agrees that no change or changes, extension of time or extensions of time, alteration or alterations or addition or additions to the terms of the Contract or to the Work to be performed thereunder, or the

specifications or drawings accompanying same shall in any wise affect its obligations on this bond, and it does hereby waive notice of any such change or changes, extension of time or extensions of time, alteration or alterations or addition or additions to the terms of the Contract or to the Work or to the specifications or drawings.

2. It is expressly agreed that this bond shall be amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract not increasing the Contract Price more than 20 percent in excess of the original Contract Price, so as to bind the Principal and Surety to the full and faithful performance of the Contract as so amended. The term "amendment" shall include any alteration, addition, extension, or modification of any character whatsoever.

3. If pursuant to the Contract Documents the Contractor shall be declared in default by the Owner under the aforesaid Contract, the Owner shall take possession of the Project and finish the Work by whatever method the Owner may deem expedient, in accordance with Article 7 of the General Conditions.

4. Supplementary to and in addition to the foregoing, whenever the Owner shall notify the Surety that the Owner has notice that the Contractor has failed to pay any subcontractor, materialman, or laborer for labor or materials certified by the Contractor as having been paid for by the Contractor, the Surety shall, within thirty (30) days of receipt of such notice, cause to be paid any unpaid amount for such labor or materials.

5. It is expressly agreed by the Principal and the Surety that the Owner, if it desires to do so, is at liberty to make inquiries at any time of subcontractors, laborers, materialmen, or other parties concerning the status of payments for labor, materials, or services furnished in the prosecution of the work.

6. The Surety agrees that other than as is provided in this bond it may not demand of the Owner that the Owner shall (a) perform any thing or act, (b) give any notice, (c) furnish any clerical assistance, (d) render any service, (e) furnish any papers or documents, or (f) take any action of any nature or description which is not required of the Owner to be done under the Contract Documents.

7. No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the legal successors of the Owner.

This bond is given pursuant to and in accordance with the provisions of the Georgia Procurement Manual and of Title 36, Chapter 91 of the Official Code of Georgia Annotated, as may be amended or modified from time to time, and all the provisions of the law referring to this character of bond as set forth in said sections or as may be hereafter enacted or amended and these are hereby made a part hereof to the same extent as if set out in full herein.

Remainder of Page Left Blank

[Signatures, attestations, and seals on following Page]

Signed and sealed this _____ day of _____, 20___.

Signed, sealed and delivered
in the presence of:

_____
(Insert Name of Contractor)

By: (Signed)_____

1. _____

(Printed)_____

2. _____ Attest :(Signed) _____

(Printed)_____

(CORPORATE SEAL)

Signed, sealed and delivered
in the presence of:

_____
(Insert Name of Surety)

By: (Signed)_____

1. _____

(Printed)_____

2. _____ Attest :(Signed) _____

(Printed)_____

(CORPORATE SEAL)

APPROVED AS TO FORM:

_____

_____
(Printed Name)
Attorney for the Macon Water Authority

END OF SECTION

PLACE SURETY FOR PERFORMANCE BOND HERE

SECTION 00610

PAYMENT BOND

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS:

That

_____

(Legal title and address of the Contractor)

as Principal (hereinafter referred to as "Contractor"), and _____

_____

(Legal title and address of Surety)

as Surety (hereinafter referred to as "Surety"), do hereby acknowledge ourselves indebted and firmly bound and held unto the Macon Water Authority (the "Owner"), in the amount of _____ Dollars ($_____.00) to which payment Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above bounden Principal has entered into a Contract with Owner bearing date of _____ for construction of _____ Project in accordance with the Contract Documents prepared by Owner, all of which said Contract Documents are incorporated herein by reference and made a part hereof, and are hereinafter collectively referred to as the "Contract."

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Contractor shall promptly make payment to all claimants as hereinafter defined for all labor and material supplied in the prosecution of the work provided for in said Contract Documents, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. The said Surety to this bond, for value received, hereby stipulates and agrees that no change or changes, extension of time or extensions of time, alteration or alterations or addition or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any wise affect its obligations on this bond, and it does hereby waive notice of any such change or changes, extension of time or extensions of time, alteration or alterations or addition or additions to the terms of the Contract or to the work or to the specifications or drawings.

2. It is expressly agreed that this bond shall be amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract Documents not increasing the Contract Price more than 20 percent in excess of the original Contract Price, so as to bind the Contractor and Surety to the full and faithful performance of the Contract as so amended. The term "amendment" shall include any alteration, addition, extension, or

modification of any character whatsoever.

3. A Claimant is defined as any subcontractor and any person supplying labor, materials, machinery, or equipment in the prosecution of the Work provided for in said Contract.

4. Every person or entity entitled to the protection hereunder and that has not been paid in full for labor or materials furnished in the prosecution of the Work referred to in said bond before the expiration of a period of ninety days after the day on which the last of the labor was done or performed by them, or materials or equipment or machinery was furnished or supplied by them for which such claim is made, or when they have completed its subcontract for which claim is made, shall have the right to sue on such payment bond for the amount, or the balance thereof, unpaid at the time of the commencement of such action and to prosecute such action to final execution and judgment for the sum or sums due them; provided, however, that any person or entity having direct contractual relationship with a subcontractor, but no contractual relationship, express or implied, with the Contractor, shall have the right of action upon this bond upon giving written notice to said Contractor within ninety days from the day on which such person or entity did or performed the last of the labor, or furnished the last of the materials or machinery or equipment for which such claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished or supplied or for whom the labor was performed or done; provided further that nothing contained herein shall limit the right of action to said 90-day period. Notice may be served by depositing a notice, registered mail, postage prepaid, duly addressed to the Contractor at any place the Contractor maintains an office or conducts business, including any post office or branch post office or any letter box under the control of the United States Postal Service, or notice may be served in any manner in which the sheriffs of Georgia are authorized by law to serve summons or process.

5. Every suit instituted under this section shall be brought in the name of the claimant without the Owner being made a party thereto. The official who has the custody of said bond is authorized and directed to furnish, to any person or entity making application therefor who submits an affidavit that it has supplied labor or material for such work and payment therefor has not been made, or that it is being sued on any such bond, a copy of such bond and the Contract for which it was given, certified by the official who has custody of said bond; this copy shall be primary evidence of this bond and Contract and shall be admitted as evidence without further proof. Applicants shall pay for such certified copies and such certified statements such as fees as the official fixes to cover the cost of preparation thereof, but in no case shall the fee exceed the fees which the clerks of the superior courts are permitted to charge for similar copies.

6. No action can be instituted on this bond after one year from the date of the final acceptance of the Owner.

This bond is given pursuant to and in accordance with the provisions of the Georgia Procurement Manual and of Title 36, Chapter 91 of the Official Code of Georgia Annotated, as may be amended or modified from time to time, and all the provisions of the law referring to this character of bond as set forth in said sections or as may be hereafter enacted or amended and these are hereby made a

part hereof to the same extent as if set out in full herein.

[Signatures, attestations, and seals on following Page]

Signed and sealed this _____day of _____, 20___

Signed, sealed and delivered
in the presence of:

_____
(Insert Name of Contractor)

By: (Signed)_____

(Printed)_____

1. _____

2. _____ Attest: (Signed) _____

(Printed)_____

(CORPORATE SEAL)

Signed, sealed and delivered
in the presence of:

_____
(Insert Name of Surety)

By: (Signed)_____

(Printed)_____

1. _____

2. _____ Attest: (Signed) _____

(Printed)_____

(CORPORATE SEAL)

APPROVED AS TO FORM:

_____

_____
(Printed Name)
Attorney for the Macon Water Authority

END OF SECTION

PLACE SURETY FOR PAYMENT BOND HERE

SECTION 00700
GENERAL CONDITIONS

Article 1. - Notice of Award of Contract. Within sixty (60) days after receipt of Bids, the Owner will notify the successful Bidder of the award of the Contract. Should the Owner require additional time to award a Contract, the time may be extended by the mutual agreement between the Owner and the successful Bidder. If an award of Contract has not been made within 60 days from the Bid date or within the extension mutually agreed upon, the Bidder may withdraw the Bid without further liability on the part of either party.

Article 2. - Execution of Contract Documents. (a) *Time Limits.*—Within fifteen (15) days of notification of Award of Contract, the Owner will furnish the Contractor with conformed copies of Contract Documents for execution by the Contractor and the surety. The Contractor and its surety must execute the bond forms contained in the conformed Contract Documents without any changes. Within ten (10) days after receipt, the Contractor shall return all the Contract Documents properly executed by the Contractor and the surety. Attached to each set of Contract Documents shall be original powers-of-attorney for the person executing the Bonds for the surety and certificates, endorsements, and declarations of insurance for the required insurance coverages, all as required by Article 3 and Article 4. Within thirty (30) days after receipt of the conformed Contract Documents properly completed and executed by the Contractor and the surety together with the power-of-attorney, and the proper certificates, endorsements and declarations of insurance, the Owner will complete the execution of the Contract Documents. Distribution of the completed Documents will be made upon execution by the Owner.

(b) *Failure of Contractor or Surety to Execute Documents.*—Should the Contractor or the surety fail to properly execute the Documents within the specified time the Owner will have the right to proceed on the Bid Bond accompanying the Bid.

(c) *Failure of Owner to Execute Documents.*—If the Owner fails to execute the Documents within the time limit specified, the Contractor will have the right to withdraw the Bid without penalty. In such event the Owner will have no liability to the Contractor under these Documents or otherwise.

(d) *Extensions of Time.*—Should either party require an extension of any of the time limits stated above, this shall be done only by mutual agreement between both parties.

(e) Changes to Documents.-- Insertion, addition, alteration, modification, revision, or deletion of any text, verbiage, provision, statement, term, condition, or other component of the Contract Documents, whether textual, numerical, or pictorial, is prohibited and no such unilateral change to

the Contract Documents shall be binding. In the event the Owner discovers any attempt by the Contractor to modify the Contract Documents by insertion, addition, alteration, revision, or deletion of any text, verbiage, provision, statement, term, condition, or other portion of the Contract Documents without the written assent and approval of the Owner, the Owner shall have grounds to withdraw the contract award, terminate all proceedings related to contractual relationship with the Contractor for the subject Project, and to award the contract to the next bidder which met the requirements of the invitation to bid.

(f) *Incorporation of Prior Agreements*. — All agreements between the parties are incorporated into this Agreement. In the event of any conflict or inconsistency between this Agreement and any provisions, terms or conditions of any other prior agreement, the provisions, terms and conditions of this Agreement shall supersede, control and prevail over the conflicting or inconsistent provisions of the prior agreement.

Article 3. - Contract Security.—The Contractor shall furnish separate Performance and Payment Bonds each in a sum equal to the amount of the Contract Price on the Owner's forms. Such Bonds shall be executed by the Contractor and a bonding company licensed to transact such business in Georgia and named on the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor.

If at any time a surety on any such Bond is declared bankrupt, becomes insolvent, loses its right to do business in Georgia or is removed from the list of Surety Companies accepted on Federal Bonds, the Contractor shall, within ten (10) days after notice from the Owner to do so, substitute acceptable Bonds in such form and sum and signed by such other surety as may be satisfactory to the Owner. The premium on such substitute Bonds shall be paid by the Contractor. No further progress payments shall be deemed due, nor shall any be made, until the new surety furnishes acceptable Bonds to the Owner. The person executing the substitute Bonds on behalf of the surety shall submit with the Bonds valid powers-of-attorney certified to by an official of said surety company.

Article 4. - Insurance—Proof of insurance coverage and furnishing of insurance policies acceptable to the Owner shall be as set forth in this Article.

(a) *Policies, Certificates, Limits and Disposition of Documents.*—The Contractor shall obtain at his expense insurance with limits as shown hereinbelow, unless the Contractor desires to broaden the limits and obtain more protection. The Contractor shall provide the Owner with all insurance documentation and evidence of insurance as required herein, and updated certificates of all insurance required herein must be provided to the Owner at least quarterly until Final Payment.

(1) WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE.—The Contractor shall procure and maintain Worker's Compensation and Employers Liability

Insurance for all of his employees to be engaged in Work on the project under this contract, and in case any such Work is sublet, the Contractor shall require the Subcontractor similarly to provide Worker's Compensation and Employer's Liability Insurance for all of the latter's employees to be engaged in such work unless such employees are covered by the protection afforded by the Contractor's insurance. Worker's Compensation insurance policies shall include GEORGIA under Section 3A and shall include Other States coverage and Voluntary Compensation.

Worker's Compensation Limits:	Statutory
Employers Liability Limits:	
Each Accident	$1,000,000
Disease - Policy Limit	$1,000,000
Disease - Each Employee	$1,000,000

Contractor waives all rights against Owner and its agents, officers, directors, and employees for recovery of damages to the extent these damages are covered by the worker's compensation and employer's liability or commercial umbrella liability insurance obtained by Contractor pursuant to Article 4 of this agreement. The Waiver of Our right To Recover From Others Endorsement, ISO Form SC 00 03 13 shall be attached to the policy showing the Owner listed in the Schedule.

Disposition: Certificate(s) of insurance showing the required coverage and copy of declaration page must be returned to the Owner with properly executed Contract Documents. If requested by the Owner, Contractor shall also provide a certified copy of the policy(ies) required by Article 4(a)(1).

(2) COMMERCIAL GENERAL AND UMBRELLA LIABILITY INSURANCE.—The Contractor shall procure and shall maintain commercial general liability (CGL) and if necessary, commercial umbrella insurance with a limit of not less than $2,000,000 each occurrence, as shall protect him and any Subcontractor performing Work covered by this Contract from claims for damages for bodily injury, including accidental death, as well as from claims for property damages, which may arise from operations under the Contract Agreement, whether such operations are by himself or by any Subcontractor or by anyone directly or indirectly employed by either of them.

CGL insurance shall be written on ISO occurrence form CG 00 01 10 93 (or substitute form providing equivalent coverage) and shall cover liability arising from premises, operations, independent contractors, products-completed operations, personal injury and advertising injury, and liability assumed under an insured contract (including the tort liability of another assumed in a business contract). If such CGL insurance contains a general aggregate limit, it shall apply separately to this project, (Per Project Aggregate Endorsement). Each policy shall be indorsed with ISO Form CG 25 03 11 85 or equivalent form with wording satisfactory to Owner.

The Owner shall be included as an additional insured under the CGL, using ISO additional insured endorsement CG 20 33 or a substitute providing equivalent coverage, and under the commercial umbrella, if any. This insurance shall apply as primary insurance with respect to any other insurance or self-insurance programs afforded to the Owner.

There shall be no endorsement or modification of the CGL limiting the scope of coverage for liability arising from explosion, collapse, or underground property damage.

Contractor waives all rights against the Owner and its agents, officers, directors, and employees for recovery of damages to the extent these damages are covered by commercial general liability or commercial umbrella liability insurance maintained pursuant to Article 4 of this agreement.

Disposition: Certificate(s) of insurance showing the required coverage and copy of declaration page must be returned to the Owner with properly executed Contract Documents. If requested by the Owner, Contractor shall also provide a certified copy of the policy(ies) required by Article 4(a)(2).

(3) BUSINESS AUTO AND UMBRELLA LIABILITY INSURANCE.—The Contractor shall procure and shall maintain business automobile liability, and if necessary, commercial umbrella liability insurance with a limit of not less than $2,000,000 each occurrence.

Such insurance shall cover liability arising out of any auto (including owned, hired, and non-owned autos).

Business auto coverage shall be written on ISO form CA 00 01, CA 00 05, CA 00 12, CA 00 20 or a substitute form providing equivalent liability coverage. If necessary, the policy shall be endorsed to provide contractual liability coverage equivalent to that provided in the 1990 and later editions of ISO form CA 00 01. This insurance shall apply as primary insurance with respect to any other insurance or self-insurance programs afforded to the Owner. Owner is named as additional insured.

Contractor waives all rights against the Owner and its agents, officers, directors, and employees for recovery of damages to the extent these damages are covered by the business auto liability or commercial umbrella liability insurance obtained by Contractor pursuant to Article 4 of this agreement or under any applicable auto coverage.

Disposition: Certificate(s) of insurance showing the required coverage and copy of declaration page must be returned to the Owner with properly executed Contract Documents. If requested by the Owner, Contractor shall also provide a certified copy of the policy(ies) required by

Article 4(a)(2).

Cross-Liability Coverage.—If Contractor's liability policies do not provide the standard ISO separation of insureds provision, or a substantially similar clause, they shall be endorsed to provide cross-liability coverage.

(3) By proper endorsement, the policy must name

MACON WATER AUTHORITY
537 Hemlock Street
P. O. Box 108
Macon, GA 31202

as an additional insured and shall provide for not less than thirty (30) days prior written notice before cancellation or any material change in the policy, except for non-payment of premium which shall require ten (10) days prior written notice of cancellation, to the Owner.

(4) Commercial Umbrella/Excess Policy:

Contractor shall procure a commercial umbrella or excess policy with a limit of no less than $5,000,000. Coverage must follow form over underlying policies including GL, Auto and Employer's Liability insurance.

(5) MATERIALS AND EQUIPMENT FLOATER. - The Contractor shall procure, and shall maintain during the performance of the Contract Agreement, Materials and Equipment Floater (May be labeled as *Equipment Floater* or Installation Floater or Builders Risk) Insurance to protect the interests of the Owner, the Contractor and Subcontractors against loss by vandalism, malicious mischief, and all hazards included in a standard All Risk Endorsement. The amount of insurance shall at all times equal or exceed the amount of the materials in the Contract + *$30k for Owner furnished materials.* The policies shall be in the names of the Owner and the Contractor.

Disposition: Original policy must be returned to the Owner with properly executed Contract Documents. Owner may accept with returned, executed Contract Documents in lieu of an original policy, an insurance binder evidencing the policy coverage, but Contractor shall not be relieved of the obligation to furnish the actual policy.

Endorsement on Materials and Equipment Floater Policy.—There shall be attached to and made a part of the insurance policy for MATERIALS AND EQUIPMENT FLOATER an endorsement of the insurance company in accordance with the specimen shown in preceding Paragraph (a)(3).

Article 5. - Hazards and Indemnification. (a) *Hazards.* —The Contractor shall be responsible

from the time of his execution of the Contract Documents or from the time of the beginning of the first work, whichever shall be earlier, for all injury or damage of any kind resulting from the Work to persons or property regardless of who may be the owner of the property. It is the intention of this paragraph to shift the full and complete risk of all such loss to the Contractor for the period of construction and until notice from the Owner of the final acceptance of the Work is made in accordance with Article 30, regardless of whether or not any particular hazard shall be insured against.

(b) *Indemnification.*—In addition to the liability imposed upon the Contractor on account of bodily injury (including death) or property damage, which liability is not impaired or otherwise affected hereby, the Contractor assumes the obligation to save the Owner harmless and to indemnify and defend the Owner, the Engineer and their agents and employees from and against all claims, damages, losses and expenses including claims consultant's and attorney's fees arising out of or through bodily injury, sickness, disease or death of any person or persons or damage to property (regardless of who may be the owner of the property) including the loss of use resulting therefrom arising out of or suffered through any act or omission of the Contractor or any Subcontractor, or anyone either

(1) directly or indirectly employed by the Contractor, or
(2) under the supervision of the Contractor or any subcontractor in the prosecution of the Work required by the Contract Documents.

In any and all claims against the Owner or the Engineer, or any of their agents or employees, by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, this indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workers' compensation acts, disability benefit acts or other employee benefits acts.

(c) *Sole Negligence Exception.* —The Contractor shall not be liable or responsible for loss or damage, and the indemnity obligation set forth above will not apply if the incident from which the loss or damage arose was the result of the sole negligence or sole cause of the Owner, the Engineer, or their agents, servants and employees.

Article 6. - Notice to Proceed. The Notice to Proceed will be issued, following the pre-construction conference, within thirty (30) days of the execution of the Contract Agreement by the Owner. The time may be extended by mutual agreement between the Owner and the Contractor. If the Notice to Proceed has not been issued within the thirty (30) day period or within the period mutually agreed upon, the Contractor may terminate the Contract Agreement without further liability on the part of either party.

Within ten (10) days of receiving the Notice to Proceed, the Contractor must initiate on-site

construction activity. If on-site construction activity is not initiated within this time period, the Owner may begin proceedings for Termination of Work for Default.

Article 7. - Termination of Work for Default. —(a) *Definition.*—The Work may be terminated for default if any one of the following events or circumstances occurs:

(1) The Contractor is adjudged bankrupt or becomes insolvent;

(2) The Contractor makes a general assignment for the benefit of creditors;

(3) A trustee or receiver is appointed for the Contractor or for any of Contractor's property;

(4) The Contractor files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or applicable laws;

(5) The Contractor fails to supply sufficient skilled workmen, materials or equipment;

(6) The Contractor fails to make satisfactory progress toward timely completion of the Work;

(7) The Contractor fails to make prompt payments to Subcontractors or material suppliers for labor, materials or equipment;

(8) The Contractor disregards laws, ordinances, rules, regulations, or orders of any public body having jurisdiction of the Work;

(9) The Contractor fails to comply with directives of the Engineer; or,

(10) The Contractor otherwise violates any provision of the Contract Documents.

(b) *Grounds for Issuance of Notice of Declaration of Default.* —It shall be a sufficient ground for the issuance of a notice of declaration of default that the Contractor has been unfaithful or delinquent in the performance of the Contract or any part of it in any respect. The Engineer does not have authority to declare the Contractor in default.

(c) *Termination of Services and Possession of the Project.* —The Owner may, without prejudice to any other right or remedy and after giving the Contractor and surety written notice ten (10) days in advance, terminate the services of the Contractor and take possession of the Project, the Work and of all products thereon owned by the Contractor, and finish the Work by whatever

method the Owner may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct and indirect costs of completing the Project and all Work, including compensation for additional professional services, such excess shall be paid to the Contractor. If such costs exceed such unpaid balance, the Contractor or surety shall pay the difference to the Owner. Such costs incurred by the Owner will be determined by the Engineer and incorporated in a Change Order.

(d) *Effect of Termination.* —Where the Contractor's services have been so terminated by the Owner, said termination will not affect any right of the Owner against the Contractor then existing or which may thereafter accrue. Any retention or payment of monies by the Owner due the Contractor will not release the Contractor from compliance with the Contract Documents.

Article 8. - Termination for Convenience of Owner. (a) *General.* —If, for any reason other than those provided for under Article 7, the Owner elects to discontinue, in whole or in part, the Work under this Contract, the Owner may, ten (10) days after delivery of a written notice to the Contractor and the Engineer, terminate, in whole or in part, the Contractor's performance of the Work under this Contract. The notice of termination shall specify the extent to which performance of the Work under the Contract is terminated.

(b) *Entitlement to Payment.* —In the event of such termination by the Owner, the Contractor shall be entitled to payment for the Work properly performed up to the time of the termination and reimbursement for such actual costs as are reasonably incurred by the Contractor due to the termination and not otherwise compensated. The Contractor shall also be entitled to profit on the amounts payable to the Contractor, but such profit shall be limited to six (6%) percent of such amounts. The Contractor shall not be entitled to any payment, including any anticipated profit, on Work not performed, and the Contractor shall not be entitled to any compensation or recovery of damages for any other costs, losses, or damages of any nature.

Article 9. - Assignments. The Contractor shall not assign the whole or any part of this Contract or any monies due or to become due hereunder without prior written consent of the Owner.

Should the Owner consent, in writing, to Contractor's assigning of all or any part of any monies due, or to become due, under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of any assignee in and to any monies due or to become due to the Contractor shall be subject to any set-offs then due to the Owner and to prior liens of all persons, firms, and corporations for services rendered or materials supplied for the performance of the Work called for under this Contract.

Article 10. - Subcontractors, Materialmen, Suppliers and Employees. —(a) *Submission of List*. -As soon as possible after notice of award of the Contract and in any event not later than the time fixed in the Contract for delivery of the executed Contract Documents to the Owner, the Contractor

shall submit in writing to the Engineer a list of the names of Subcontractors that the Contractor will engage for the Work. The list of Subcontractors is not submitted for approval, but is for the purpose of establishing:

(1) What trades and portions of the Work are to be performed under subcontract; and,

(2) The names of the entities selected by the Contractor to perform work by subcontract, the aforesaid selection being a matter lying solely within the discretion of the Contractor.

The Contractor shall utilize the services of specialty Subcontractors on those parts of the Work which, under normal construction practices, are best performed by specialty Subcontractors and as may be required by the Engineer in the Engineer's sole discretion, at no additional cost to the Owner. If the Contractor desires to self-perform specialty Work, the Contractor shall submit a notice to the Owner accompanied by evidence that the Contractor's own organization has successfully performed the type of work, and the performance of the Work by specialty Subcontractors will result in materially increased costs or inordinate delays.

(b) *No Approval of Subcontractors*.—Neither the Owner nor the Engineer undertakes to pass upon or approve any Subcontractor.

(c) *Warranty of Contractor.*—The Contractor warrants that the Subcontractors selected by the Contractor are reputable, skilled, reliable, competent, qualified in the trade or field in which such Subcontractors are to perform Work on the Project, and that all Subcontractors are thoroughly familiar with applicable codes.

(d) *Certification on account of.*—The Engineer shall, upon written request, furnish to any Subcontractor, wherever practicable, evidence of the amounts certified as payable or paid on the Subcontractor's account. Furnishing any such evidence shall not establish any relationship between the Engineer and any Subcontractor.

(e) *Contractor Responsible for Acts and Omissions of Subcontractors, Materialmen, Suppliers and Employees*.—The Contractor agrees that it is as fully responsible for the acts and omissions of its Subcontractors, materialmen, suppliers, and employees (and of entities either directly or indirectly employed by any of them) as the Contractor is for the acts and omissions of entities directly employed or engaged by the Contractor. The failure of a Subcontractor, materialman, supplier, or employee to timely and properly perform any Work shall not be asserted by the Contractor as an excuse for any omission from, or noncompliance with, the requirements of the Contract Documents; nor shall the Contractor be entitled to an extension of the Contract Time because of any failure of a Subcontractor, materialman, supplier, or employee to timely perform the Work unless such failure was a direct result of some critical delay to the Subcontractor,

materialman, supplier or employee of the kind and character described under Article 28 of the General Conditions for which the Contractor shall have requested and received an extension of time under the terms of Article 28 of the General Conditions. The subcontracting of work does not relieve the Contractor of the full responsibility for the execution of the Work and for compliance with all requirements of the Contract Documents. The Contractor may not assert negligence, inefficiency, insolvency, bankruptcy, or incompetence of any Subcontractor, materialman, supplier, or employee as excuse for any noncompliance with methods and material designated in the Contract Documents. As to Subcontractors, materialmen, suppliers and employees of the Contractor, the doctrine that a principal is liable for acts and omissions of his agent shall be binding on the Contractor, and the Contractor may not reverse the aforesaid doctrine by serving as a conduit or agent for its Subcontractors, materialmen, suppliers and employees. Any provision in any Contract between the Contractor and any Subcontractor pursuant to which the Contractor is obliged to present to the Owner any claim of any Subcontractor shall be invalid, null and void.

(f) *No Contract Between Owner and Any Subcontractor, Materialman, Supplier, or Employee*.—Nothing contained in the Contract Documents shall create any contractual relationship between the Owner and any Subcontractor or between the Owner and any materialman, supplier or employee of the Contractor or its Subcontractors.

(g) *Relationship of Contractor and Subcontractors.*—The Contractor agrees to bind every Subcontractor to, and every Subcontractor agrees to be bound by, the terms of the Contract Documents, including the following provisions of this Article:

The Subcontractor agrees

(1) To be bound to the Contractor by the terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities that the Contractor by the Contract Documents assumes toward the Owner.

(2) To submit to the Contractor applications for payment in such reasonable time as to enable the Contractor to apply for payment under Article 30 of the General Conditions.

(3) To make claims for extras, for extensions of time or for damages to the Contractor in the manner provided in the General Conditions for like claims by the Contractor upon the Owner.

The Contractor agrees

(1) To be bound to the Subcontractor by all the obligations that the Owner assumes to the Contractor under the Contract Documents.

(2) To pay the Subcontractor upon the payment of certificates issued under the schedule of values described in Article 24 of the General Conditions the amount allowed to the Contractor on account of the Subcontractor's work to the extent of the Subcontractor's interest therein; amounts retained by the Contractor from payments due to Subcontractors (expressed as a percentage) shall not exceed that being retained by the Owner.

(3) To pay the Subcontractor as required by the Contract Documents.

(4) To pay the Subcontractor on demand for its work or materials as far as executed and fixed in place, less the retained percentage, even though the Engineer fails to approve payment to the Contractor for any cause not the fault of the Subcontractor.

(5) To pay the Subcontractor a just share of any fire insurance money received by the Contractor.

(6) To make no demand for liquidated damages or penalty for delay in any sum in excess of such amount as may be specifically identified in the subcontract.

(7) That no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten days of the calendar month following that in which the claim originated.

(8) To give the Subcontractor an opportunity to be present and to submit evidence in any dispute involving rights of the Subcontractor.

(b) *Owner Not Obligated to any Subcontractor.*—There is no obligation on the part of the Owner to pay, or to see to the payment of, any sums to any (1) Subcontractor, (2) materialman, (3) supplier, (4) laborer, (5) employee, or (6) claimant as defined in the Payment Bond.

(c) *Incorporation of Terms in Subcontracts*.—The Contractor agrees that failure on its part to incorporate in all subcontracts an express provision in accordance with this Article shall be deemed to be and is a breach of an essential covenant, and that, in the event of such breach, that Contractor shall, within five (5) days after demand of the Owner, furnish proof in writing that the deficiency has been remedied and that (1) the Contractor may not maintain that it is beyond the Contractor's right or ability to require performance of terms of the Contract Documents by a Subcontractor and (2) no Subcontractor may maintain that it has not assumed toward the Contractor all the obligations and responsibilities that the Contractor has assumed toward the Owner.

Article 11 - Engineer.—(a) *Supervision.*—The Engineer shall have general supervision and

direction of the Work except in respect to safety and except as qualified by Articles 27 and 36 of the General Conditions. He/she shall make visits to the Project site and make determination as to whether the Work is proceeding in accordance with the Contract Documents. The Engineer is an independent contractor and acts as the agent of the Owner only when in special instances he/she is authorized in writing by the Owner so to act, and in such instances he/she shall, upon request, show the Contractor written authority. The Engineer has authority to stop the Work whenever such stoppage may be necessary to ensure the proper execution of the Contract.

(b) *Interpreter and Impartial Judge.*—As the Engineer is the interpreter of the conditions of the Contract and the judge of its performance, the Engineer shall side neither with the Owner nor with the Contractor but shall use the Engineer's powers to enforce the faithful performance of the Contract by both the Owner and the Contractor.

(c) *Succession.*—In case of the termination of the employment of the Engineer, the Owner shall appoint a capable and reputable Engineer against whom the Contractor shall make no objection and whose status under the Contract shall be that of the former Engineer.

(d) *Promptness.*—The Engineer shall make decisions with reasonable promptness after presentation of evidence on (i) any claim of the Owner or Contractor, (ii) a demand of the Owner or Contractor for a decision on any matter relating to the execution, or progress, of the Work, or (iii) a demand of the Contractor or Owner for interpretation of or additional instructions ("Request for Information" or "RFI") with respect to the Contract Documents.

(e) *Engineer's Authority.*—The Engineer shall be vested with the authority to judge, determine and direct the following:

(1) Whether products furnished are of the quality, type and kind called for by the Contract Documents and are otherwise acceptable for the Work as provided in the Contract Documents, and if not, to reject those not so qualifying or otherwise unacceptable;

(2) Whether products incorporated in the Work comply with the standards and requirements of the Contract Documents as to installation and operation and, if not, to require their removal and replacement, at the expense of the Contractor, with products which do meet the qualifications and operating ability, requirements, performance and standards as provided in said Contract Documents;

(3) The accuracy of quantities, amount of Work performed and all other submittals by the Contractor submitted in partial or periodic payment estimates, and whether all or any part of such quantities and other submittals are acceptable and comply with the

Contract Documents, and to disallow any submittals not approved by the Engineer until the deficiencies causing such disallowance have been eliminated and rectified;

(4) The validity and merit of any and all claims for additional compensation or extension of the Contract Time;

(5) All matters relating to artistic effect;

(6) The validity and reasonableness of any notice of facility interruption given under Article 20 of the General Conditions; and,

(7) All other matters relating to the proper execution of the Work in conformity with the Contract Documents, including workmanship.

The determination and decision, and any resulting approval, non-approval, condemnation, rejection, requirements of removal or replacement in all the foregoing matters of or by the Engineer shall be final and conclusive and binding upon the Contractor, all Subcontractors and all suppliers of products materials and equipment.

(f) *Claims for alleged procrastination.*—No claim for delay to the Contractor or for additional expense to the Contractor shall commence to accrue on account of failure of the Engineer to render decisions, make interpretations, or furnish additional instructions until ten (10) days after receipt of written claim for additional compensation, damages, or extension of time served upon the Engineer and the Owner and not then unless such claim be reasonable and otherwise permitted under the Contract Documents.

Article 12. - Separate Contracts.—(a) *Cooperation of Contractor.*—The Owner reserves the right to let other contracts in connection with, or related to, this Project. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their products and the execution of their work, and the Contractor and other contractors shall properly connect and coordinate their respective work with each other. If the proper execution or results of any part of the Contractor's Work depends upon the work of any other contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such other contractor's work that render it unsuitable for such proper execution and results.

(b) *Performance of Work by Owner.*—The Owner may perform additional work related to the Project with Owner's own forces. The Contractor shall afford the Owner reasonable opportunity for the introduction and storage of products and the execution of such work and shall properly connect and coordinate Contractor's work with work performed by Owner's own forces.

(c) *Claims for Extra Expense.*—If the performance of additional work by other contractors or

the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof will be given to the Contractor prior to starting any such additional work. If the Contractor believes that the performance of such additional work by the Owner or others causes the Contractor any additional expense or entitles the Contractor to an extension of the Contract Time, the Contractor may make a claim therefor as provided in Article 29 of the General Conditions.

Article 13. - Laws and Regulations. (a) *General.*—The Contractor acknowledges and agrees that all applicable federal, state, county and city laws, municipal ordinances, and the codes, rules, and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Contract as though written out in full herein. The Contractor shall keep fully informed of all laws, ordinances and regulations of the federal, state, county, city and municipal governments or authorities in any manner affecting those engaged or employed in the Work or the material used in the Work or in any way affecting the conduct of the Work and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same. If any discrepancy or inconsistency should be discovered in these Contract Documents herein referred to, in relation to any such law, ordinance, regulation, order or decree, the Contractor shall herewith report the same, in writing, to the Owner and the Engineer.

(b) *Expense for Violation of Laws, Ordinances, etc.*—If the Contractor performs any work knowing or reasonably knowing it to be contrary to such laws, ordinances, rules or regulations without such notice to the Owner, the Contractor shall bear all costs arising therefrom.

(c) *Indemnification.*—The Contractor shall at all times observe and comply with all such existing and future laws, ordinances, and regulations, and shall protect and indemnify the Owner, the Engineer and their agents against the violation of any such law, ordinance regulation, order or decree, whether by the Contractor or by the Contractor's employees or Subcontractors.

(d) *Drug Free Workplace Act.*—The Contractor certifies that the provisions of O.C.G.A. §§ 50-24-1 through 50-24-6 (as may be amended or re-numbered) relating to the "Drug Free Workplace Act" will be complied with in full. The Contractor further certifies that: (i) A Drug Free Workplace will be provided for employees during the performance of the Contract, and (ii) that if a Subcontractor is engaged by the Contractor to work in a Drug Free Workplace, the Contractor shall secure from the Subcontractor the following written certification:

"As part of the subcontracting agreement with _____ (Contractor's name) , _____ (Subcontractor's name) certifies to the Contractor that a drug-free workplace will be provided for the Subcontractor's employees during the performance of this Contract pursuant to the 'Drug Free Workplace Act'". Contractor also certifies to the Owner and the Engineer that the Contractor and its employees will not engage in the unlawful manufacture, sale, distribution, dispensation, possession, or use of any controlled substance or marijuana during the performance of the Contract.

(e) *Alcoholic Beverages on the Jobsite.*—The Contractor will strictly enforce a policy prohibiting the possession and consumption of alcoholic beverages on the jobsite before, during or after working hours for duration of the Work.

Article 14. - Taxes. (a) *General.*—The Contractor shall pay all sales, consumer, use and other similar taxes required by the law of the place where the Work is performed. The Owner will be responsible for any sales or use tax due on products furnished by the Owner to the Contractor to be incorporated into the Work.

(b) *Tabulation.*—The Contractor shall provide a written tabulation, plus other documentation as may be required, of all taxes, including sales tax, paid by the Contractor to assist the Owner in obtaining sales or use tax refunds for eligible machinery and equipment used for the primary purpose of reducing or eliminating air or water pollution as provided for in Chapter 48-8-3 (36) and (37) of the Official Code of Georgia (as may be amended). Such written tabulation shall be included with each partial payment request. Additionally, the tabulation shall be documented with copies of invoices indicating the amount of tax paid, with all blanks completed on the invoice, and with a description of the function of the item included in the tabulation. All taxes will be paid by the Contractor. All refunds will accrue to the Owner.

Article 15. - Notice and Service Thereof. (a) *General.*—All notices, demands, requests, instructions, approvals, and claims shall be in writing.

(b) *Notice to Contractor.*—Any notice to or demand upon the Contractor will be sufficiently given if delivered at the office of the Contractor specified in the Bid (or at such other office as the Contractor may from time to time designate to the Owner in writing), or if delivered by the United States Mail in a sealed, postage-prepaid envelope, or delivered by facsimile transmission, followed by written confirmation, in each case addressed to such office.

(c) *Notice to Owner.*—All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to:

Macon Water Authority
537 Hemlock Street
Macon, GA 31201
FAX (478) 750-2007

Any notice to or demand upon the Owner shall be sufficiently given if delivered to the Office of the Executive Director or if delivered by the United States Mail in a sealed, postage-prepaid envelope, or delivered by facsimile addressed to said Executive Director or to such other representative of the

Owner or to such other address as the Owner may subsequently specify in writing to the Contractor for such purposes. Any such notice or demand shall be deemed to have been given to the Owner or made only as of the time of actual delivery to Owner.

(d) *Delivery to Engineer or Resident Inspector.*—Notice in writing or orally to the Engineer or to the resident inspector is not notice to the Owner unless a copy of the aforesaid notice in writing shall have been properly served upon the Owner as provided in this Article.

Article 16. - Patents and Royalties. (a) *General.*—If the Contractor uses any patented, trademarked or copyrighted design, process, device, material or other item, , the Contractor shall provide for such use by suitable agreement between the Owner and the holder of such patented, trademarked or copyrighted design, device or material. The Contract Prices shall include royalties or costs arising from the use of such design, device, or materials, in any way involved in the Work.

(b) *Indemnification.*—The Contractor and the Contractor's surety shall indemnify and save harmless the Owner, the Engineer and their agents from claims for infringement by reason of the use of such patented, trademarked or copyrighted design, process, device or materials in connection with Work agreed to be performed under this Contract, and shall indemnify the Owner, the Engineer and their agents for any cost, expense, damage and reasonable attorneys' fees which the Owner, the Engineer or their agents 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.

Article 17. - Land and Rights-of-Way. (a) *Project Site.*—The Owner will provide, as indicated in the Contract Documents and prior to the Notice to Proceed, the lands upon which the Work is to be performed, rights-of-way for access thereto, and such other lands which are designated for the use of the Contractor. The Contractor shall confine all Work and all associated activities to the easements and other areas designated for the Contractor's use. The Contractor shall comply with any limits on construction methods and practices which may be required by easement agreements.

(b) *Delays in Providing Access.*—If, due to some unforeseen reason, the necessary easements are not obtained, the Contractor shall receive an equitable extension of Contract Time or an equitable increase in the Contract Price, or both, to cover the Contractor's additional costs as a result thereof, provided the Owner is notified in writing of the claim. The Contractor's claim therefor shall be made as provided for in Article 29 of the General Conditions.

(c) *Additional Easements.*—Should additional temporary easements for ingress or egress be required by the Contractor for access to the Work, these easements shall be obtained by the Contractor, at no additional cost to the Owner.

Article 18. - Products. (a) *Storage.*—Products shall be stored in accordance with the manufacturer's recommendations to insure the preservation of their quality and fitness for the Work.

Stored products to be incorporated in the Work shall be located so as to facilitate prompt inspection by the Owner or the Engineer.

(b) *Installation.*—Manufactured products shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer.

(c) *Conformance with Shop Drawings.*—Products shall be furnished in accordance with shop drawings or samples submitted by the Contractor and approved by the Engineer.

(d) *Quality and Ownership.*—Unless otherwise specified, all products incorporated into the Work shall be new, and both workmanship and materials shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of products. The burden of proof is on the Contractor. Products to be incorporated into the Work shall not be purchased by the Contractor or Subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

Article 19. - Supervision of Work. (a) *Supervision by Contractor.*—The Contractor shall give efficient supervision to the Work, using its best skill and attention. The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

(b) *Superintendent of Contractor.*—The Contractor shall employ and maintain on the Work a qualified superintendent and any necessary assistants, all satisfactory to the Owner and Engineer, who shall have been designated in writing by the Contractor as the Contractor's representative at the site. The superintendent shall not be changed except with the consent of the Owner and Engineer unless the superintendent proves to be unsatisfactory to the Contractor and ceases to be in the Contractor's employ. The superintendent shall represent the Contractor and shall be present on the site at all times as required to perform adequate supervision and coordination of the Work. The superintendent's sole responsibility shall be to superintend the construction of the Project; he shall not be a "working foreman." The superintendent shall have full authority to act on behalf of the Contractor and to execute orders or directions of the Engineer without delay. The superintendent shall have full authority to promptly supply products, tools, plant equipment and labor as may be required. The superintendent's authority shall be such that all communication given to the supervisor shall be as binding as if given to the Contractor.

(c) *Contractor's Personnel.*—The Contractor shall employ only competent and skilled personnel. The Contractor shall at all times enforce strict discipline and good order among its employees and shall not employ on the Work any unfit person or anyone not skilled in the work assigned to him. The Contractor shall, upon demand from the Engineer, immediately remove any superintendent, foreman, or worker whom the Engineer or Owner may consider incompetent or undesirable.

Article 20. - Interruption of Facility Operations. (a) *General.*—The Contractor shall provide the Owner with written notice at least five (5) days prior to any interruption in facility operations required by any construction activity. The notice shall include the date and time of the scheduled interruption; the length of time the interruption will be in effect; the procedures to be followed in effecting the interruption; a complete identification of all those processes, equipment and operations to be affected; and all other information the Owner may require. The Contractor shall provide any and all equipment, piping, auxiliary power or other means necessary to sustain facility operations or function for interruptions which have not been identified by the Contract Documents, or when interruptions must exceed the time allowed by the Contract Documents.

(b) *Damages and Fines.*—Any damages resulting from surcharging, overflow or back-up caused by the Contractor's operations shall be the Contractor's responsibility. Any fines levied against the Owner resulting from a surcharge, overflow or backup caused by the Contractor shall be paid by the Contractor.

Article 21. - Protection of Work, Property and Persons. (a) *Duty to Protect Persons and Property.*—The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide necessary protection to prevent damage, injury or loss to all employees on the Work and other persons who may be affected thereby, all the Work and all products to be incorporated therein, whether in storage on or off the site, and other property at the site and adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction. The Contractor shall pay for any such damage, injury, or loss except such as may be directly the result of errors in the Contract Documents or such as shall be caused directly by agents or employees of the Owner.

(b) *Safety Precautions.*—The Contractor shall comply with the Occupational Safety and Health Act, the Contract Work Hours and Safety Standards Act, and all rules and regulations relating thereto. Contractor warrants and represents that it is thoroughly familiar with the safety requirements with regard to scaffolding set forth in O.C.G.A. § 25-15-110, the requirements concerning blasting or excavating near underground gas pipes and utility facilities contained in O.C.G.A. § 25-9-1, *et seq.*, and the High Voltage Safety Act, O.C.G.A. § 46-3-30, *et seq.*, and that the Work shall be prosecuted in complete accord with all limitations and requirements set forth in these, and other applicable, laws. The contractor's operation of the jobsite shall be consistent with the provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., and shall maintain an accurate record of all cases of death, occupational disease, and injury requiring medical attention or causing loss of time from work arising out of and in the course of employment on the Work. The Contractor alone shall be responsible for the safety, efficiency, and adequacy of its plant, appliances, and methods and for any damage which may result from their improper construction, maintenance, or operation. The

Contractor shall erect and properly maintain at all times as required by the conditions and progress of the work proper safeguards for the protection of workers and the public and shall post danger warnings against any hazards created by the construction operations. The Contractor shall designate a responsible member of its organization on the Work whose duty shall be the prevention of accidents. In the absence of notice to the contrary filed with the Engineer in writing with a copy to the Owner, this person shall be the superintendent of the Contractor.

(c) *Emergencies.*—In an emergency affecting the safety of life or the Work or adjoining property, the Contractor, without special instruction or authorization from the Engineer or Owner, is hereby permitted to act, at its discretion, to prevent such threatened loss or injury. Any remuneration claimed by the Contractor on account of emergency work shall be determined in accordance with allowances permitted on force account under section (c), Case(c) of Article 29 of the General Conditions.

(d) *Injury or Loss to Persons or Property.*—The Contractor shall remedy all damage, injury or loss to any property, improvements or facilities caused, directly or indirectly, in whole or in part, by the Contractor or any of the Contractor's Subcontractors or anyone directly or indirectly employed by and of them or anyone for whose acts any of them may be liable. The property, improvements or facilities shall be replaced or restored to a condition as good as when the Contractor entered upon the Work. In case of failure on the part of the Contractor to restore such property, or pay for such damages or injury, the Owner may, after 48 hours written notice, proceed to repair, rebuild, or otherwise restore such property, improvements or facilities as may be deemed necessary. The cost thereof will be deducted from any monies due or which may become due to the Contractor under this Contract.

(e) *Blasting.*—In the absence of an express provision in the Contract Documents permitting blasting, there shall be no blasting. If blasting is permitted under the Contract Documents and under the law which is applicable to the Project site, such blasting shall be done in such manner as to prevent all damage and injury.

(f) *Rain Water, Surface Water, and Backup.*—The Contractor shall protect all Work, including but not limited to excavations and trenches, from rain water, surface water, and back-up of drains and sewers. The Contractor shall furnish all labor, pumps, shoring, enclosures, and equipment necessary to protect and keep the Work free of water. Completed Work and stored products shall be suitably protected during inclement weather to allow Work to proceed in a timely fashion. Work planned, or in progress, should be performed to minimize impact of adverse weather conditions.

Article 22. - Protection of the Environment. (a) *General.*—The Contractor shall be responsible for taking all measures required to minimize all types of pollution associated with the undertaking of the proposed Work, and shall abide by the requirements of all governmental agencies having

jurisdiction over the Work or Contractor's Project operations.

(b) *Restoration.*—Any area used or involved in the Project that is disturbed by the Contractor, shall be restored to original or better condition, even though such area is outside the limits of that specified for grading, grassing or landscaping.

Article 23. - Protection, Location and Relocation of Utilities. (a) *Notification and Protection.*—The Contractor shall notify owners of adjacent utilities when prosecution of the Work may affect them. The Contractor shall protect from damage all existing improvements or utilities at, or in proximity to, the site of the Work, and shall repair or restore any damage to such facilities resulting from the performance of the Work. If the Contractor fails or refuses to repair any such damage promptly, the Owner may have the Work performed and charge the cost thereof to the Contractor.

(b) *Relocation.*—Prior to the construction or installation of any proposed facility or pipeline, the Contractor shall expose all existing utilities true to their vertical and horizontal location, within the vicinity of the Work. In order to avoid conflicts between existing and proposed facilities or utilities, the Contractor shall either relocate the existing or proposed utility on a temporary or permanent basis, or shall take whatever means necessary to protect the existing facilities or utilities during the installation of proposed utilities, as approved by the Engineer. No separate or additional payment will be made for the relocation of existing utilities or for any work associated with the protection of existing facilities or utilities.

Article 24. - Schedules, Reports and Records.—(a) *Progress Reports.*—Within such reasonable time as the Owner shall designate in writing, the Contractor shall submit to the Owner such schedule of quantities and costs, construction progress schedules, payrolls, bills, vouchers, correct copies of all subcontracts, statements, reports, correct copies of all agreements, correspondence, and written transactions with the surety that have any relevance to the Work, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under this Contract. When requested by the Owner, the Contractor shall give the Owner access to accounts relating to the foregoing. The above reports shall include but are not limited to (i) written notice of dates by which specified Work will have been completed, (ii) written notice of dates by which condemned Work shall have been remedied, (iii) written notice that condemned Work has been remedied, (iv) written notice as to the date or dates by which Work that has not been performed with equal steps and at the same rate required by the construction progress schedule shall have been brought into conformity with the schedule, (v) written notice of the date by which any undisputed claim of a Subcontractor, materialman, or laborer shall have been paid, (vi) written advice regarding the nature and amount of any disputed claim of a Subcontractor, materialman, or laborer, and (vii) information regarding work performed under Sections (c), Case (b) and Case (c) of Article 29 of the General Conditions.

(b) *Construction Progress Schedule.*—Within ten (10) days of the Notice to Proceed, the

Contractor shall submit to the Engineer a Preliminary Progress Schedule ("PPS") and a Near Term Schedule ("NTS") in the form and with the content required by the Specifications. Within forty-five (45) days of the Notice to Proceed, the Contractor shall submit to the Engineer the Overall Project Schedule ("OPS") as required in the Specifications.

(c) *Schedule of Values.*—The Contractor shall, within ten (10) days of the Notice to Proceed, submit to the Engineer a Schedule of Values of the various parts of the Work, including quantities, aggregating the total Contract Price, divided in such manner as to facilitate payments to Subcontractors in accordance with Article 10, with a complete breakdown of the Contract Price so arranged and so itemized in accordance with the Specifications as to meet the approval of the Engineer, and, if requested, supported by such evidence as to its correctness as the Engineer may direct. This schedule, designated herein as the Schedule of Values, when approved by the Engineer shall be used as a basis for certificates of payment.

(d) *Shop Drawings.*—The Contractor shall prepare, execute, and submit shop drawings as required by the Specifications. No shop drawings shall be submitted which do not comply with the Contract Documents.

(e) *Schedule of Submittals.*—Within ten (10) days of the Notice to Proceed, the Contractor shall prepare and submit for the approval of the Engineer a Schedule of Submittals showing the estimated date of submittal of all shop drawings and the desired approval date for each shop drawing anticipated. The Contractor shall submit in accordance with the schedule and the Engineer shall furnish approval in accordance with the schedule. The schedule must be consistent with the construction progress schedules.

(f) *Submitting Updated Schedules.*—An updated OPS and NTS together with an updated Schedule of Submittals shall be presented with each periodical payment request. Failure to timely submit such schedules will delay processing of the pay request until receipt of the updated schedules.

(g) *Float in the Schedule.*—If the OPS reflects a completion date prior to the completion date established in the Contract Agreement, or as extended by Change Order, this shall afford no basis for a claim of delay should the Contractor not complete the Work prior to the projected date set forth in the OPS. All "float" between the completion date in the OPS and the completion date established in the Contract Agreement shall belong to and be exclusively available to the Owner. Should a Change Order be executed with a revised completion date, the progress schedule shall be revised to reflect the new completion date.

(h) *Record Drawings.*—The Contractor shall maintain on the Project site throughout the Contract Time an up-to-date set of records and drawings as required by the Specifications.

(i) Project Coordination Meetings.—The Contractor shall participate in Project Coordination Meetings to be held on the site monthly, or more often if conditions warrant, to establish the current state of completion and revise the schedule as necessary. The Project Coordination Meeting will be conducted by the Owner and the Engineer.

(j) *Maintenance of Project Scheduling System.*—The Contractor shall take the following steps to ensure that the Project stays on schedule:

(1) The Contractor shall implement the detailed NTS of activities to the fullest extent possible between Project Coordination Meetings.

(2) The Contractor shall provide a copy of the Contractor's Daily Report to the Resident Inspector by 10:00 a.m. of the day following the Report date. This Daily Report will contain, as a minimum, the weather conditions; number of workers by craft, including supervision and management personnel on site; active and inactive equipment on site; Work accomplished by Critical Path Method activity item; problems; and visitors to the jobsite.

(3) If a current activity or series of activities on the OPS is behind schedule and if the late status is not due to an excusable delay for which an extension of the Contract Time would be forthcoming, the Contractor shall attempt to reschedule the activity to be consistent with the OPS so as not to delay completion of the Contract. The Contractor agrees that:

a. The Contractor shall attempt to expedite the activity to completion so as to have it agree with the OPS. Such measures as the Contractor may choose shall be made explicit during the Project Coordination Meeting;
b. If, within two weeks of identification of such behind-schedule activity, the Contractor is not successful in restoring the activity to an on-schedule status, the Contractor shall:
    1. Carry out the activity with the scheduled crew on an overtime basis until the activity is complete or back on schedule;
    2. Increase the crew size or add shifts so the activity can be completed as scheduled; or,
    3. Commit to overtime or increased crew sizes for subsequent activities, or some combination of the above as deemed suitable by the Engineer.

    These actions shall be taken at no increase in the Contract Price.

(4) Maintain a current copy of all construction schedules on prominent display in the Contractor's field office at the Project site; and,

(5) Cooperate with the Owner or Owner's representative in all aspects of the Project Scheduling System. Failure to implement the Project Scheduling System or to provide specified schedules, diagrams, and reports, or to implement actions to re-establish progress consistent with the OPS may be causes for withholding of payment.

Article 25. - Drawings and Specifications.

(a) *Identification.*— The Contract Documents shall be as defined in Article 41(e) of the General Conditions. They are intended to define, describe, and provide for all Work necessary to complete the Project in an acceptable manner, ready for use, occupancy, or operation by the Owner. Insertion, addition, alteration, modification, revision, or deletion of any text, verbiage, provision, statement, term, condition, or other component of the Contract Documents, whether textual, numerical, or pictorial, is prohibited and no such unilateral change to the Contract Documents shall be binding.

(b) *Number of Copies.*—The Engineer will furnish the Contractor two copies of the Contract Documents, one copy of which the Contractor shall have available at all times on the Project site. Any additional copies will be furnished at additional cost.

(c) *Correlation and Intent.*—The Contract Documents are complementary, and what is called for by one shall be as binding as if called for by all. The intention of the documents is to include all labor and materials, equipment, and transportation necessary for the proper execution of the Work. It is not intended, however, that materials or work not covered by or properly inferable from any heading, branch, class, or trade of the Specifications shall be supplied unless distinctly noted on the drawings. Materials or Work described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized standards. In the event the Engineer shall have used such phrases anywhere in the Specifications as: “work indicated on the drawings and herein specified”, “work shown and specified”, “in accordance with the drawings and Specifications”, “indicated on the drawings and Specifications”, “in accordance with Specifications and applicable drawings”, ”these Specifications and the accompanying drawings”, “as indicated on the drawings and as specified herein”, or similar expressions, they shall not be deemed to be and are not a defeasance of the provisions under this Article of the General Conditions, and they are not to be construed as requiring Work to be called for both in the Specifications and in the drawings in order to be a requirement under the Contract. Any of the aforesaid conjunctive expressions and phrases or any cross-references between drawings and Specifications, between Specifications and Specifications, or between drawings and drawings to the contrary notwithstanding, the Contract Documents are complementary, and what is called for by one shall be as binding as if called for by all.

(d) *Refinement of Documents.*—The Contractor shall do no Work without complete, definite, and clear Drawings and Specifications. In the event the Contract Documents are not complete,

definite, and clear, the Contractor shall make demand upon the Engineer, in writing, for a Request for Instructions (RFI) in accordance with Section (d) (iii) of Article 11 of the General Conditions. A copy of such demand shall be served upon the Owner. With reasonable promptness the Engineer shall furnish complete, definite, and clear instructions in writing, or by means of drawings, or in writing and by means of drawings. Such additional instructions if given orally shall be confirmed in writing or by drawings or both within a reasonable time. All such additional instructions shall be consistent with the Contract Documents, true developments thereof, and reasonably inferable therefrom. The Work shall be executed in conformity with the aforesaid instructions. The Engineer shall furnish the Owner a copy of all additional instructions issued to the Contractor. No clarification of the Drawings and Specifications hereunder by the Engineer will entitle the Contractor to any additional monies unless a Change Order has been processed as provided by Article 29 of the General Conditions.

(e) *Conflicts.*—The following principles shall govern the settlement of disputes which may arise over conflicts in the Contract Documents:

(i) as between figures given on drawings and the scaled measurements, the figures shall govern;

(ii) as between large-scale drawings and small-scale drawings, the larger scale shall govern;

(iii) As between Drawings and Specifications, the requirements of the Specifications shall govern;

(iv) as between the form of the Contract Agreement, General Conditions or agency funding documents, the requirements of the agency funding documents shall govern; and,

(v) in cases where products or quantities are omitted from the Specifications, the description and quantities on the Drawings shall govern.

Conflicts noted shall be reported to the Engineer. The principles set forth herein shall not alter the provisions of subsection (c) herein. Schedules, lists, indexes, tables, inventories, written instructions, written descriptions, summaries, statements, classifications, specifications, written selections, or written designations although appearing on the drawings are deemed to be and are "Specifications" within the meaning of this Article.

(f) *Materially Differing Site Conditions.*—Any materially differing site condition as between what is shown on the Drawings and Specifications and actually found on site shall be immediately reported to the Engineer and Owner, in writing, prior to the continuance of Work at the site. Failure of the Contractor to notify the Engineer, in writing, of the differing site condition prior to performance of Work at the site shall constitute a waiver of any claim for additional monies. Any Change Order necessitated by the differing site condition shall be processed as provided under

Article 29 of the General Conditions. Any Work done by the Contractor following a discovery of such differing site condition or ambiguity or need for clarification in the Contract Drawings and Specifications, prior to a written report to the Engineer, shall not entitle the Contractor to additional monies and shall be done at the Contractor's risk.

Article 26. - Surveys and Permits.—(a) *Surveys.*—The Owner will furnish a land survey to establish a base line for locating the principal component parts of the Work, as shown in the Contract Documents. A bench mark will be otherwise specified in the Contract Documents; the Contractor shall develop and make all detailed surveys needed for construction, such as alignment, slope stakes, batter boards, stakes for pile location and other working points, lines, elevations and cut sheets.

(b) *Permits.*—Permits and licenses of a temporary nature necessary for the prosecution of the Work shall be obtained and paid for by the Contractor. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be obtained and paid for by the Owner unless otherwise specified.

Article 27. - Testing, Inspection and Rejection of Work.—(a) *Testing of Materials.*—Unless otherwise specifically provided for in the Specifications, the inspection and testing of materials and products to be incorporated in the Work at the site shall be made by bureaus, laboratories, or agencies approved by the Owner; the cost of such inspection and testing shall be paid by the Contractor. The Contractor shall furnish evidence, satisfactory to the Owner and Engineer, that the materials and products have passed the required tests prior to their incorporation into the Work. The Contractor shall promptly segregate and remove rejected materials and products from the site of the Work.

(b) *Access to Work.*—The Owner and Engineer and their representatives shall at all times have access to the Work wherever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and for inspection.

(c) *Notice to Engineer from Contractor Prior to Covering Work.*—If the Specifications, the Engineer's instructions (either in the Specifications or issued later in writing), laws, ordinances or any public authority require any Work to be specially tested or approved, the Contractor shall give the Engineer timely notice in writing of its readiness for inspection, and if the inspection is by any authority other than the Engineer, of the date fixed for such inspection. Inspections by the Engineer shall be made promptly and where practicable at the source of supply. If any Work should be covered without approval or consent of the Engineer, it must, if required by the Engineer, be uncovered for examination at the Contractor’s expense.

(d) *Re-examination or Re-testing of Work Covered pursuant to Consent of Engineer.*—Re-examination or re-testing of questioned work covered pursuant to consent of the Engineer may be

ordered by the Engineer, and if so ordered the Work must be uncovered by the Contractor. If such Work is found in accordance with the Contract Documents the Owner shall pay the cost of re-examination and replacement or of re-testing. If such Work is found not in accordance with the Contract Documents the Contractor shall pay such cost unless he shall show that the defect in the Work was caused by another contractor of the Owner, and in that event the Owner shall pay such cost. Re-examination or re-testing under the terms of this section applies only to Work which has been covered with consent of the Engineer. Work covered without consent of the Engineer must be uncovered for examination as provided under Article 27(c) of the General Conditions.

(e) *Inspection Does Not Relieve Contractor.*—Under the Contract Documents, the Contractor has assumed the responsibility of furnishing all services, labor, and materials for the entire Work in accordance with such documents. No provisions of this Article or any inspection of the Work by the Owner, representatives of the Owner, resident inspector, clerk-of-the-works, architects employed by the Engineer, representatives of the Engineer, or the Engineer shall in any way diminish, relieve, or alter said responsibility and undertaking of the Contractor; nor shall the omission of any of the foregoing to discover or to bring to the attention of the Contractor the existence of any Work or materials injured or done not in accordance with said Contract Documents in any way diminish, relieve, or alter such obligation of the Contractor nor shall the aforesaid omission diminish or alter the rights or remedies of the Owner as set forth in the Contract Documents. Subject to the provisions of Section (g) herein, the resident inspector has no power to make decisions, to accept or reject Work, or to consent to the covering of Work. The resident inspector owes no duty to the Contractor.

(f) *False Start.*-In the event notice of readiness pursuant to Article 30(g) of the General Conditions shall have been issued prematurely by the Contractor, the Contractor's action shall be deemed to be a "false start", and the Contractor shall be liable for the damage resulting from the aforesaid false start, including but not limited to the salary, professional fees, and travel and living expenses of the person or parties inconvenienced by the aforesaid false start.

(g) *Authority and Duties of the Resident Inspector.*—The Resident Inspector will be authorized to inspect all Work done and all products furnished, including preparation, fabrication and manufacture of the products to be used, but the Resident Inspector is not authorized to alter or waive any requirements of the Contract Documents. The Resident Inspector may temporarily reject products or suspend the Work until any question at issue can be referred to and decided by the Engineer. The responsibility of the Contractor is not lessened by the presence of the Resident Inspector.

(h) *Rejection of Work; Orders of Condemnation.*—The Contractor shall remove from the premises within the time designated in orders of condemnation all Work condemned by the Engineer as failing to conform to the Contract Documents, whether incorporated in the Work or not, and the Contractor shall promptly replace and re-execute the Work in accordance with the Contract

Documents and without expense to the Owner and shall bear the expense of making good all work of other contractors destroyed by such removal or replacement. The Contractor shall supply any omitted Work and perform all unexecuted Work within the time fixed by the Engineer in orders of condemnation.

(i) *Remedy of the Owner for Breach of Order of Condemnation.*—If the Contractor does not make good a deficiency within the time fixed in an Order of Condemnation, the Owner may:

(1) Remove the condemned Work and store it at the expense of the Contractor. If the Contractor does not pay the expenses of such removal and storing within ten (10) days after receipt of written demand of the Owner, the Owner may upon three (3) days' notice in writing to the Contractor sell such materials at private sale or at auction and shall account for the net proceeds thereof after deducting all proper costs incurred by the Owner; or

(2) Supply omitted Work, perform unexecuted Work, or replace and re-execute Work not done in accordance with the methods and materials designated in the Contract Documents and deduct the cost thereof from any payment then or thereafter due the Contractor; or,

(3) Accept the condemned Work and deduct the reasonable value of such Work from the Contract Price.

The remedies stated in this Article are in addition to the remedies otherwise available to the Owner, do not exclude such other remedies, and are without prejudice to any other remedies. Time limits stated in orders of condemnation are of the essence of the Contract. Unless otherwise agreed to by the Owner in writing, the making good of condemned Work shall physically commence at the site in not more than seven (7) days after receipt of the Order of Condemnation except that in case of emergency correction shall physically commence immediately and except that the Contractor shall in any event physically commence the correction at the site early enough to complete within the time allowed in the Order of Condemnation. The Owner shall give prompt consideration to reasonable requests for delay in commencement of the making good of orders of condemnation. The making good of condemned Work shall be completed within the time allowed in the Order of Condemnation unless the Contractor shall have requested from the Engineer an increase in the amount of time allowed and the Engineer shall have given notice to the Contractor in writing, with copy to the Owner, stating the additional time, if any, allowed. An extension of the time allowed to correct condemned Work shall not extend the Contract Time.

(j) *Notice of Correction from Contractor.*—The Contractor shall give prompt notice in writing to the Engineer, with copy to the Owner, upon completion of the correction of any Work, the supplying of any omission of any Work or materials or the performance of any unexecuted Work

condemned by the Engineer. In the absence of such notice, it shall be and is presumed under this Contract that there has been no correction, supplying remedy, or performance of unexecuted Work.

Article 28. - Contract Time and Liquidated Damages. (a) *Rate of Progress.*—The Contractor shall proceed with the Work at a rate of progress which will insure substantial completion of the Project within the Contract Time. It is expressly understood and agreed by and between the Contractor and the Owner that the Contract Time for the Work is a reasonable time, taking into consideration the average climatic and economic conditions, and other factors prevailing in the locality of the Work. It is understood that the Contractor's proposed construction schedule is based on a normal 40-hour work week, less recognized holidays. If the Contractor desires to work in excess of a normal 40-hour work week, the Contractor shall submit a written request to the Owner and Engineer a minimum of two (2) days prior to the desired work date. The Contractor shall be responsible for any additional expenses incurred by the Owner as a result of any extended work hours, including resident inspection overtime. The cost associated with resident inspector overtime will be deducted from the Contractor's monthly progress payment request.

(b) *Grounds for Delays and Extensions of Time.*—If the Contractor be delayed at any time in the progress of the Work by any act or neglect of the Owner or the Engineer, or of any employee of either, or by any separate contractor of the Owner, or by changes ordered in the Work, or by strikes, lockouts, pickets, abnormal and unforeseeable weather, unforeseeable subsurface conditions, fire, unusual delay in transportation, unavoidable casualties, or any causes beyond the Contractor's control, or by any cause which the Engineer shall decide to justify the delay, then the Contract Time may be extended for such reasonable time as the Engineer may decide.

(c) *Filing of Claims.*—No extension of the Contract Time shall be made for delay occurring more than ten (10) days before claim therefor is made in writing to the Engineer with a copy to the Owner. In the case of a continuing cause of delay, only one claim is necessary, but no claim for a continuing delay shall be valid unless the Contractor, within ten (10) days of the commencement of the delay, shall have given notice in writing to the Engineer, with copy to the Owner.

(d) *Weather Delays.*—The Contractor is held to be familiar with weather conditions in the Macon-Bibb County area. When a claim for extension of the Contract Time is based on abnormal and unforeseeable weather conditions the request must be accompanied by U.S. Weather Bureau data for the past ten (10) years for the Macon/Macon-Bibb County, Georgia area that substantiates the claim of abnormal and unforeseeable weather conditions. Each day of inclement weather is not, by itself, reason for an extension of the Contract Time. Extensions of the Contract Time will be based solely on the number of rain days in a monthly period that are in excess of the ten (10) year average as established for the Macon/Macon-Bibb County area. A rain day, for purposes of calculating the ten (10) year average, is defined as a day in which 0.10 inch of rain or more was measured by the Weather Bureau.

(e) *Delay in Furnishing Drawings.*—If no Schedule of Submittals or agreement stating the dates upon which drawings or approval of shop drawings shall be furnished is made, then no claim for delay shall be allowed on account of failure of the Engineer to furnish drawings or approval of shop drawings until fourteen (14) days after demand therefor and not then unless such claim be reasonable.

(f) *No Damages for Delay.*—In the event of any delay as set forth in Section (b) herein, the Contractor may be entitled to an extension of the Contract Time only, and shall not be entitled to any additional payment on account of such delay. Without limiting the foregoing, except as otherwise specifically provided under Article 29, the Contractor shall not be entitled to payment or compensation of any kind from the Owner for direct, indirect or impact damages, including but not limited to costs of acceleration or extended home office overhead arising because of hindrance or delay from any cause whatsoever, whether such hindrances or delays be reasonable or unreasonable, foreseeable or unforeseeable, or avoidable or unavoidable.

(g) *Liquidated Damages.*—If the Contractor shall fail to perform the Work required within the Contract Time, or extended Contract Time if authorized by Change Order, then the Contractor shall pay Owner the full amount of liquidated damages specified in the Contract Documents for each calendar day that the Contractor shall be in default after the time stipulated in the Contract Documents shall have expired, and the Owner shall deduct such liquidated damages from the Contractor's monthly progress payment request.

Article 29. - Changes in the Work.—(a) *Owner's Right to Make Changes.*—The Owner without invalidating the Contract may authorize or order extra work or may authorize or order changes by altering, adding to, or deducting from the Work, the Contract Price or the Contract Time, or both, being adjusted accordingly. The Contractor hereby expressly agrees that the Contractor shall have no right to a claim for damages or extended overhead of any nature because of changes made by the Owner. Such Work is hereinafter designated "change" or "changes".

(b) *Field Orders.*—The Engineer may at any time, by issuing a field order, make changes in the details of the Work. These changes by field order will not affect Contract Time or Contract Price. The Contractor shall proceed with the performance of any such changes in the Work so ordered by the Engineer, unless the Contractor believes that such field order entitles Contractor to a change in Contract Price or Contract Time, or both, in which event Contractor shall give the Engineer immediate, written notice thereof and if required by the Owner, an immediate estimate of the direct cost of Work as outlined in Case (b) below, after the receipt of the ordered change, and the Contractor shall not execute such changes pending the receipt of an executed Change Order or further written instruction from the Owner.

(c) *Cost to Owner for Changes.*—The cost to the Owner of any change shall be determined in one or more of the following ways:

CASE (a) By estimate and acceptance in a lump sum.

CASE (b) By unit prices identified in the Contract or subsequently agreed upon. Unit prices are net including overhead and profit. Neither establishment of unit prices in the Contract or later agreement to unit prices shall entitle the Contractor to execute any change under Case (b) prior to issuance of an authorization or order of the Owner in writing.

CASE (c) By force account, which is defined as expenditures allowed under Article 29(i) plus a percentage or percentages as stated under Article 29(i).

(d) *Changes Forbidden without Consent of Owner.*—Neither the Engineer or the Contractor shall make any change whatsoever in the Work without authorization or order of the Owner in writing except in emergency as described hereinbelow. The making of any change without authorization or order of the Owner in writing is a breach of contract except in emergency as referred to under Article 21 of the General Conditions. In the absence of authorization or order of the Owner given in advance in writing (except in emergency as referred to under Article 21 of the General Conditions) the Contractor shall have no claim for payment, repayment, reimbursement, remittance, remuneration, compensation, profit, cost, overhead, expense, loss, expenditure, allowance, charge, demand, hire, wages, salary, tax, cash, assessment, price, money, bill, statement, dues, recovery, restitution, benefit, recoupment, exaction, injury, damages or time based upon or resulting from any change.

(e) *Notice of demand of Contractor for extraordinary remuneration or for damages.*—For a change in the Work, the Contractor shall be entitled to no claim other than or in excess of allowances permitted under Article 29(i) unless prior to commencement of execution of the change (a) the Contractor shall have notified the Owner in writing of the nature of the claim and (b) the Owner shall have agreed in writing to the claim. Commencement of execution of a change authorized by the Owner in the absence of the aforesaid written notice from the Contractor and written agreement to the claim by the Owner shall be deemed to be and is conclusive proof that the Contractor acknowledges that it makes no claim other than or in excess of allowances permitted under Article 29(i).

(f) *Subsurface Conditions.*—Material below the surface of the ground is assumed to be earth and other material that can be removed by a backhoe or similar equipment. Should conditions encountered below the surface of the ground be at variance to conditions indicated by Drawings, Specifications, or geotechnical reports, and subject to Article 23 of the General Conditions, the Contract Price may be adjusted as provided in this Article for changes in the Work upon claim by either party made in writing within a reasonable time after the first observance of the conditions; PROVIDED, however, that the Contractor shall in any event give written notice to the Owner

before proceeding to execute any change resulting from subsurface conditions; and PROVIDED FURTHER; that the Owner shall not be liable to the Contractor for any claim occasioned by the aforesaid subsurface conditions except in accordance with and pursuant to authorization of the Owner issued in writing prior to commencement of execution of the aforesaid change to which authorization the Contractor shall have taken no exception. If exception to the authorization be taken by the Contractor, the Owner may issue an order pursuant to Article 29(i). Commencement of execution of work pursuant to Article 29(i) shall not exclude the recovery of damages by the Contractor under other Articles of the General Conditions, but the cost to the Owner for the changes executed pursuant to the aforesaid order shall not exceed the "net allowable expenditures" permitted to the Contractor under Article 29(i) plus the "allowance for overhead and profit" permitted under Article 29(i).

(g) *Rock.*—If rock, as hereinafter defined, is encountered, no claim for additional compensation for changes shall lie against the Owner in the absence of previous authorization by the Owner in writing, and the cost to the Owner for any changes shall be determined as provided in this Article. ***CAUTION: No rock for which extra compensation is expected to be received shall be removed except pursuant to and in conformity with a written authorization or order of the Owner.*** Shale, rotten stone, or stratified rock that can be loosened with a pick or removed by a backhoe or similar equipment shall not be classified as rock. Rock is defined as follows: any material which cannot be excavated with conventional equipment, and must be removed by drilling, chemical cracking, or blasting, and occupies an original volume of at lease one-half cubic yard.

(h) *Existing Conditions.*—The Contractor in undertaking the Work under this Contract is assumed to have visited the premises and to have taken into consideration all conditions which might affect the Work. No consideration will be given any claim based on lack of knowledge of existing conditions except where existing conditions are such as cannot be readily ascertained. Any claims relating to conditions which were not readily ascertainable shall be adjusted as provided in this Article for changes in the Work.

(i) *Cost to Owner, Allowances for Contractor, and Allowable Expenditures.*—In Cases (a) and (c), above, the "allowance for overhead and profit" combined, included in the total cost to the Owner, shall be based upon the following schedule:

(1) For the Contractor an allowance for Work which it performs with its own forces, not to exceed 16% of its "net additional allowable expenditures", if any, for changes.

(2) For a Subcontractor an allowance for Work which it performs with its own forces, not to exceed 16% of its "net additional allowable expenditures", if any, for changes. A Subcontractor shall receive no allowance for overhead and profit on Work not performed by its own forces. Under these Contract Documents, the

forces of a Sub-subcontractor of a Subcontractor are deemed to be and are the forces of the Subcontractor.

(3) For the Contractor an allowance for Work performed by its Subcontractor, not to exceed 10% of the amount, if any, due the Subcontractor for changes.

The above percentages shall be applied to the "net additional allowable expenditures", if any, as limited and defined herein. If the net difference between "allowable expenditures" and savings results in a decrease in expenditures, the amount of credit allowed the Owner shall be the net decrease without any credit for profit and overhead. "Net additional allowable expenditures" as used herein shall mean the difference between all "allowable expenditures" and savings. The term "allowable expenditures" is limited to and defined as items of:

(1) Labor which is defined as the specific labor wages including a thirty percent (30%) markup on the cost of direct payroll wages. The Contractor shall furnish, if required by the Owner, certified payrolls to verify wages.

(2) Material delivered and used on the designated Work, including sales tax, if paid for by the Contractor and as verified by original invoices or otherwise verifiable to the Engineer's acceptance.

(3) Rental, or Ownership cost of equipment, including necessary transportation of equipment, having a purchase value in excess of $300.00. Rental or Ownership cost will be allowed for only those hours during which the equipment is required on the Project site. Cost allowances will not exceed the rates defined as follows: the hourly rate, for equipment not used exclusively in the change to the scope of Work, will be the monthly rate, as printed in the current Rental Blue Book for Construction Equipment published by Dataquest, divided by 176; the rate, for equipment used exclusively for those tasks identified in the change to the scope of Work, will be the daily, weekly or monthly rate, used singularly or in combination, which will provide the lowest total cost. The rates will be modified by the Rate Adjustment Table factors to reflect a depreciation allowance indexed to the year a machine was originally manufactured and sold. The rates will be adjusted to account for regional differences in annual use hours, cost of labor, freight, taxes, etc. The amount by which basic rates will be increased or decreased is shown on the adjustment maps included in the "Blue Book". The equipment use period will begin only at the time equipment is unloaded at the site of the changed Work; will include each day that the equipment is required at the site of the changed Work; and will terminate at the end of the day on which the use of such equipment becomes unnecessary, plus reasonable transportation time. The maximum time to be paid per day will not exceed eight hours unless the equipment is in operation for a longer time. The time which will be paid for per day for equipment not used

exclusively in the change to the scope of Work, will be the hours which the equipment was actually in operation on the changed Work.

(4) In cases where there is an extension of the Contract Time, *pro rata* expenditures for time of foremen employed in the direct superintendence of productive labor in execution of changes.

All expenditures not included in the term "allowable expenditures" as limited and defined in this Article shall be considered as overhead, including, but not limited to, bond premiums, supervision, travel (meals, transportation, and lodging), superintendence [except *pro rata* time of foremen as referred to herein], timekeepers, clerks, watchmen, hand tools, small tools, incidental job burdens, engineering, drafting, and office expense. Any other provisions in the Contract Documents to the contrary notwithstanding, only demonstrable, direct, out-of-pocket expenditures for the changes plus percentages as set forth hereinabove shall be allowable for changes. No wages of a foreman shall be allowable for a change carried on concurrently with contract Work unless the claim includes a demand for extension of time caused by the authorizing or ordering of the change.

(j) *Execution of Changes Pursuant to Order.*—In the event neither Case (a) nor Case (b) can be mutually agreed upon as the method of determining the cost to the Owner for a change, the Contractor, provided it receives a written order from the Owner, shall proceed on force account under Case (c), and he shall keep and present in such form as the Engineer may direct a correct account of the expenditures together with vouchers. Allowable expenditures shall in no event exceed current costs for like services and materials, the burden of proof being on the Contractor.

(k) *Stipulated Maximum Sum.*—Under Case (b) and Case (c), the Owner shall prescribe the limits of any authorization or order for a change by means of an authorization or order in writing stipulating the maximum sum of money committed toward execution of the said change, and the Contractor shall have no authority to perform any change which will cost the Owner in excess of the stipulated maximum sum. It shall be solely the Contractor's responsibility ***to apply in writing to the Owner, NOT [repeat NOT] to the Engineer***, for an enlargement of the scope of the authorization or order by an increase in the said stipulated maximum sum if during the course of the performance of a change on force account under Case (c) the additional cost of the change to the Owner as established in accordance with allowable expenditures and allowances for profit and overhead permitted under Article 29(i) is approaching, or may exceed, the said stipulated maximum sum. It shall likewise be the responsibility of the Contractor to apply for an enlargement of the scope of the authorization or order if the total value of units at any agreed unit price under Case (b) is approaching the said stipulated maximum sum. For changes in the Work no claim for payment, repayment, reimbursement, remittance, remuneration, compensation, profit, cost, overhead, expense, loss, expenditure, allowance, charge, demand, hire, wages, salary, tax, cash, assessment, price, money, bill, statement, dues, recovery, restitution, benefit, recoupment, exaction, injury or damages shall lie against the Owner for any amount in excess of such amount as shall have been

mutually agreed to under Case (a) or in excess of such amount as shall have been established as the stipulated maximum sum under Case (b) or Case (c). The cost to the Owner for any change in the Work, except a change based upon agreed unit prices under Case (b), shall be established in accordance with the schedule of allowances and percentages stipulated under Article 29(i).

(l) *Breakdown of Expenditures.*-To accompany all Change Orders, the Contractor shall furnish a breakdown of expenditures for labor and materials by units and quantities in the form prescribed by the Owner, and the breakdown shall be accompanied by the following declaration: "I do solemnly swear, under criminal penalty, that the costs shown hereinabove do not exceed current costs for like services or materials and do not exceed the actual costs to the Contractor therefor, and that the quantities shown do not exceed actual requirements." For all force account changes, the Contractor shall promptly, and in no event later than thirty (30) days after receipt of written demand therefor, pursuant to Article 29(i) submit to the Engineer a complete, accurate, and final breakdown and account together with vouchers, showing all expenditures and percentages allowable under Case (c). For all unit price changes, the Contractor shall promptly, and in no event later than thirty (30) days after receipt of written demand therefor, pursuant to Article 29(i) submit to the Engineer an accurate account of the quantity of Work performed under Case (b). In any case, the Engineer shall certify to the amount [including under Case (a) and Case (c) the allowance prescribed in the Contract for overhead and profit] due the Contractor. The Contractor shall obtain and furnish as back-up to the Contractor's breakdown a separate breakdown for each Subcontractor's charges prepared by each Subcontractor on the letterhead of the Subcontractor and properly signed by the Subcontractor.

(m) *Payment on Account.*—If the Contractor desires to obtain payment on account before any change in the Work has been completed, a Change Order certified by the Engineer and signed by the Contractor and the Owner must have been executed for so much of the change as has been completed at the time of the filing of the request for payment on account.

(n) *Form and Execution of Change Orders.*—Change Orders shall be recommended by the Engineer and signed by the Contractor and the Owner in accordance with the form of change order prescribed by the Owner. No request for payment of the Contractor for account of a change shall be due, nor shall any such request appear on a progress payment request or demand for final payment until (1) the Change Order shall have been certified by the Engineer and (2) a Change Order shall have been executed by the Contractor and the Owner.

(o) *Claims Distinguished from Changes.*— Claims for damages arising out of alleged negligence of the Engineer or Owner as provided for under Article 37 of the General Conditions are distinguished from claims for allowances for changes as provided for under Article 29. Claims for damages must be filed entirely separately pursuant to Article 37 of the General Conditions and claims for allowances for changes must be filed entirely separately pursuant to Article 29 unless the Contractor and Owner agree in writing otherwise.

(p) *Conditions Different from Those Indicated in Contract Documents.*—The parties contemplate delays necessary to complete tests, to redesign, and to perform change order Work in the event conditions encountered at the site are different from those indicated in the Contract Documents, or to perform change order Work to correct errors and omissions in the Drawings and Specifications. Execution of any change must be authorized. In such event there shall be an adjustment in the Contract Price as provided in the Contract for changes in the Work, but no claim for damages shall lie against the Owner for the aforesaid delays. Such delays are not a breach of contract because the parties contemplate such delays as a natural and probable consequence of construction operations. The parties agree that such delays constitute no wrong or injury, create no right to a claim for damages, and are not a ground for claiming extraordinary remuneration.

(q) *Unit Prices.*— The term "net" as used in reference to "unit prices" means in respect to Change Orders performed in accordance with Case (b) of Article 29 of the General Conditions that the unit prices offered by the Contractor and accepted by the Owner shall be inclusive of all sums for payment, repayment, reimbursement, remittance, remuneration, compensation, profit, cost, overhead, expense, loss, expenditure, allowance, charge, demand, hire, wages, salary, tax, cash, assessment, price, money, bill, statement, dues, recovery, restitution, benefit, recoupment, exaction, or injury. Upon request of the Owner in writing and within such reasonable space of time as the Owner shall designate in writing, the Contractor shall submit for consideration of the Owner proposals in writing for unit prices to be applied in the event Work is authorized by the Owner to be performed under Case (b) of Article 29. Under penalty of false swearing, a principal of the contracting firm shall certify that the unit prices submitted do not exceed current costs for like services or materials.

(r) *Combining Small Change Orders.*—The Owner may, with the Contractor's concurrence, elect to postpone the issuance of a Change Order until such time that a single Change Order of substantial importance can be issued incorporating several changes. In such cases, the Owner will indicate this intent for each change in the Contract in a written notice to the Contractor, following agreement by the Owner and Contractor on the scope, price and time, if any, of the change.

(s) *Changes in the Contract Time.*—The Contract Time may be changed only by a Change Order. Changes in the Work described in section (a) of this Article and any other claim made by the Contractor for a change in the Contract Time will be evaluated by the Engineer and if the conditions warrant, an appropriate adjustment of the Contract Time will be made. The Engineer, when making these evaluations will take into consideration the amount and scope of Work which has been changed and will evaluate if the change in Work has affected the Critical Path as currently accepted on the Progress Schedule such that it would delay the completion of the Project. If after these evaluations have been made, and in the sole opinion of the Engineer the Contractor is due an extension of the Contract Time, then it will be granted by a Change Order. Extensions of the Contract Time granted as a result of weather will not result in a change in Contract Price.

(t) *Effect of Executed Change Order*.-The execution of a Change Order by the Contractor shall constitute conclusive evidence of the Contractor's agreement to the ordered changes in the Work, the Contract as thus amended, the Contract Price and the Contract Time. The Contractor, by executing the Change Order, waives and forever releases any claim against the Owner for additional time or compensation for matters relating to or arising out of or resulting from the Work included within or affected by the executed Change Order. The foregoing waiver and release expressly includes, without limitation, claims for additional compensation or time based on the theory that the Contractor has suffered so-called "impact" damage attributable to the effect of change order Work on other change orders Work or on unchanged Work.

Article 30. - Payments and Completion.—(a) *Contract Price*.— The Contract Price is either a lump sum or the sum of the unit prices stated in the Contract Agreement, for each item multiplied by the actual quantities installed of each item, and is the total amount payable by the Owner to the Contractor for the performance of the Work set forth in the Contract Documents. It is understood that the Contractor shall provide and pay for all products, labor, (including labor performed after regular working hours, on Sundays, or on legal holidays), equipment, tools, water, light, power, sewer, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, place into operation, and deliver the Work.

(b) *Application for Payment and Receipts.*—The Contractor shall submit to the Engineer in accordance with a form to be supplied by the Owner an application for each monthly progress payment, and, if requested by the Owner or Engineer, receipts or other vouchers, showing his payments for materials and labor, including payments to Subcontractors as required by Article 10 of the General Conditions.

(c) *Progress Payments.*—If progress payments are made on valuation of Work done, such complete application shall be submitted to the Engineer at least twenty (20) days before payment falls due. In applying for payments, the Contractor shall submit a statement based upon the Schedule of Values on a progress payment form to be supplied by the Owner, and, if requested by the Engineer or Owner, itemized in such form and supported by such evidence as the Engineer or Owner may direct showing the Contractor's right to the payment claimed.

(d) *Materials stored.*—Application for payment may include, at the Contractor's option, the cost of products not yet incorporated into the Work which have been delivered to the site or to other storage locations authorized and approved by the Engineer. The Owner reserves the right to accept or reject pay requests for stored materials, and to limit payments to those stored materials which, in the Engineer's judgment, are necessary for continuing satisfactory Project progress.

Payment for stored products will be subject to the following conditions being met or satisfied:

(1) The products shall be received in a condition satisfactory for incorporation in the Work, including manufacturer's storage and installation instructions;

(2) The products shall be stored in accordance with the manufacturer's recommendations and in such manner that any and all manufacturer's warranties will be maintained and that they will not be damaged due to weather, construction operation, or any other cause;

(3) An invoice from the manufacturer shall be furnished for each item on which payment is requested. The request may include reimbursement for cost of delivery, limited to common carrier rates, to the site, but will not include the Contractor handling, on or off site, or for storage expense;

(4) The Contractor shall, on request of the Engineer, furnish written proof from the supplier of payment (less retention equal in percentage to that being retained by the Owner) for the products no later than 30 days after receipt of payment for same from the Owner. The Owner will have the right to deduct from the next payment estimate an amount equal to the payment for products if reasonable and adequate proof is not submitted; and,

(5) Shop drawings, product data and samples, showing "No Exceptions Taken", have been received from the Contractor for that specific equipment or material.

(e) *Operating Test Period.*—Upon receipt of written notice from the Contractor that the Work is ready to be placed into service for the operating test period, the Engineer will, within a reasonable time, inspect the Work. Prior to initiating the operating test, Work required by the Contract Documents must be in place and operable as determined by the Engineer, which includes, but is not limited to the following:

(1) Pressure testing all lines as required in the Specifications;

(2) Making adjustments of manhole rims;

(3) Performing functional tests and providing manufacturers' required certification as specified;

(4) Removing temporary plugs, bulkheads, bypasses, etc., and diverting flow into the facility when directed by the Engineer; and,

(5) All painting, grassing and restoration of the Work area, provided the Work area is not

part of another segment not yet in the 30-day operating test period.

When the Engineer finds the Work of the Contractor ready for initiation of the operating test period, the Engineer will recommend to the Owner that the operating test period begin.

Certain segments of the Work, whether new or existing to be modified, may need to be placed in service prior to completion of the entire Project. Prior to placing these segments in operation, the requirements above, which pertain to the operating test period, must be complete for each segment.

The operating test period begins upon written notification from the Owner and runs for a period of 30 days. During this period, the Contractor shall complete all remaining items of Work, make adjustments found to be necessary, and ensure that all equipment and systems are functioning properly, and continue to function properly. The beginning of the operating test period initiates the Owner's responsibility for providing chemicals, power, and operating personnel. The Contractor retains responsibility for maintaining equipment until acceptance by the Owner. The segments to be placed into service prior to completion of the entire Project will be determined solely by the Engineer or the Owner.

(f) *Conditions Precedent to Application for Final Payment.*—ALL WORK REQUIRED BY THE CONTRACT DOCUMENTS MUST BE COMPLETED BEFORE THE FINAL INSPECTION IS PERFORMED. This includes, but is not limited to, the following:

(1) Performing infiltration and pressure tests as described in the detailed Specifications;

(2) Removing temporary plugs, bulkheads, bypasses, etc.;

(3) Flushing all lines with potable water furnished by Contractor;

(4) Pressure testing all lines as required in the Specifications;

(5) Demonstrating the operation of all valves;

(6) Providing specified instruction for the Owner's personnel;

(7) Disinfecting all water mains as required in the Specifications; and,

(8) Grassing and restoration of the Work area.

(g) *Notification of Readiness for Final Inspection.*—When all conditions precedent for the application have been completed, the Contractor shall submit completed Record Drawings to the Engineer and give notice to the Engineer in accordance with Article 5 of the Contract Agreement

with a copy to the Owner in the following words:

> The work on the Contract for the **Replace 4160v Gear & MCC at Lower Poplar WWTP Blower Bldg.** having been fully completed except as stipulated hereinbelow, it is requested that a final inspection be made promptly by the Engineer in accordance with Article 5 of the Contract Agreement. The following Work is incomplete through no fault of the Contractor:

No final inspection shall be made until such time as the Engineer has received a letter in the exact form indicated above and a copy thereof has been received by the Owner. In the event the Contractor shall have issued the "Notice of Readiness for Final Inspection" prematurely [hereinafter referred to as "false start"] he shall be liable for the damage resulting from the aforesaid false start including but not limited to the salaries, professional fees, and travel and living expenses of the persons or parties inconvenienced by the aforesaid false start. The Contractor acknowledges and agrees that he has an indivisible, non-delegable, and non-transferable contractual obligation to the Owner to make its own inspections of the Work at all stages of construction; and the Contractor shall supervise and superintend performance of the Contract in such manner as to enable it to confirm and corroborate at all times that all Work has been executed strictly, literally, rigidly, and inflexibly in accordance with the methods and materials designated in the Contract Documents so that (a) its certifications on periodical estimates shall be true and correct and (b) its notice of readiness for final inspection shall be true and correct. Accordingly, the Contractor agrees that it may not defend or excuse any deviation from the Contract Documents on the ground (a) that the deviation was not brought to its attention by another person or party or other persons or parties or (b) that a Subcontractor is, or Subcontractors are, at fault.

(h) *Final Acceptance.*—If the Engineer finds the Work of the Contractor complete and acceptable in accordance with the provisions of the Contract Documents and that the Record Drawings accurately depict the complete Work, the Engineer will recommend to the Owner that the Project be accepted and that final payment be made. In the event that the final inspection reveals deficiencies in meeting the Contract requirements, the Contractor shall complete all remaining items of Work, and make adjustments found to be necessary. Upon receipt of written notice from the Contractor that the Work is complete and ready for re-inspection, the Engineer will make another final inspection. The Contractor will be notified, in writing, by the Owner of the final acceptance of the Work. The date of final acceptance shall be the beginning of the warranty period.

(i) *Liens.*—Neither the final payment or any part of the retained percentage shall become due until the Contractor has furnished the Owner proper and satisfactory evidence (under oath if required) that all claims for labor employed and materials used in the construction of the Work under this Contract have been paid, satisfied or waived, and that no claims can be filed against the Owner for such labor or materials. If required, the Contractor shall deliver to the Owner a complete release of all liens or claims arising out of this Contract, and an affidavit that so far as it has

knowledge or information the releases include all labor and materials for which a lien or claim could be filed; provided, however, that the Contractor may, if any Subcontractor or claimant refuses to furnish a release, furnish a bond satisfactory to the Owner to indemnify the Owner against any lien or claim. If any lien or claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the Owner may be compelled to pay in discharging such lien or claim, including all costs and a reasonable attorneys' fees.

(j) *Compliance with O.C.G.A. §§ 13-10-80 and 13-10-81.*—For purposes of O.C.G.A. § 13-10-80(b) the term "substantial completion of the Work" shall mean that "the Work has been satisfactorily completed and is accepted in accordance with the Contract Documents." If upon completion of the second "final" inspection provided for in subsection (g) of this Article there are still remaining (i) any disputed indebtedness or (ii) if there are liens upon the property, or (iii) there are any items of Work uncompleted which in the opinion of the Engineer are "incomplete items" within the meaning of O.C.G.A. §§ 13-10-80(b)(2)(B) and/or 13-10-81(c), an amount equal to two hundred percent (200%) of each such item of indebtedness, lien or uncompleted Work as determined by the Engineer shall be withheld until such item or items are paid, settled or completed and the remaining retainage shall be paid to the Contractor.

Article 31. - Certificates of Payment.—(a) *Issuance.*—If the Contractor has made application for payment as provided under Article 30, the Engineer shall not later than the date when each payment falls due issue to the Owner a certificate for such amounts as he decides to be properly due or state in writing his reasons for withholding a certificate.

(b) *Warranty of Title.*—The Contractor warrants that title to all Work and products covered by a Certificate of Payment, whether incorporated into the Project or not, will pass to the Owner upon the receipt of such payment by the Contractor, free and clear of all liens, claims, security interests or encumbrances except retention equal in percentage to that being retained by the Owner.

(c) *Effect.*—No Certificate issued, or payment made to the Contractor, or partial or entire use of occupancy of the Project by the Owner shall be an acceptance of any Work or materials not in accordance with the Contract Documents. The making of the final payment shall constitute a waiver of all claims by the Owner other than those arising from unsettled liens, from faulty work appearing after final payment, or from the requirements of the Contract Documents, including but not limited to the provisions of Article 5, Hazards and Indemnification, of these General Conditions. Acceptance of the final payment shall operate as and shall be a release by the Contractor to the Owner from all claims of any kind or character arising out of or related to the Contract except for such specific amount or amounts as may have been withheld to cover the fair value of any incomplete Work which has been certified by the Engineer under the provision of Paragraph (d) of Article 5 of the Contract Agreement as incomplete through no fault on the part of the Contractor.

(d) *Date and Rate of Payment.*—Progress payments will be made by the Owner to the

Contractor in accordance with Article 4 of the Contract Agreement. Final payment will be made in accordance with Article 5 of the Contract Agreement. The date and rate of payment are subject to Article 32 of the General Conditions. Sums retained pursuant to this Article are and remain the property of the Owner until such time as the Contractor shall have become entitled to receive payment of such retainage by complying with the full terms of the Contract Documents.

(e) *Delays in Making Payments.*—The date on which any progress payment is due shall be extended for such period of time as may be necessary in the determination of the Engineer for the Contractor to remedy any incorrect or incomplete application for payment.

(f) *Interest.*—Should the Owner fail to pay the sum named in any certificate of the Engineer when due, the Contractor shall receive, in addition to the sum approved in the certificate, simple interest thereon at the legal rate; PROVIDED, however, that the Contractor shall have given the Owner written notice of the date on which payment was properly due, and no interest shall be payable if the Owner makes payment when due or within three days after receipt of the aforesaid notice from the contractor. Such notice shall be in writing, and shall set forth:

(1)— A short and concise statement that interest is due pursuant to this Article;
(2)— The principal amount of the progress or final payment which is allegedly due to the Contractor; and,
(3)— The first day and date upon which the Contractor alleges that interest will begin to accrue, pursuant to this Article.

(g) *Integration with the Prompt Pay Act.*—The provisions of the Contract Documents with respect to time limits for payments, grounds for withholding payment, conditions authorizing payments, and interest on late payments shall supersede all provisions of the Georgia Prompt Pay Act, as originally enacted or as amended, and any dispute arising between the parties hereto as to whether or not the provisions of this Contract or the Georgia Prompt Pay Act control will be resolved in favor of the terms of these Contract Documents.

Article 32. - Payments Withheld.—The Engineer may withhold or, on account of subsequently discovered evidence, nullify the whole or a part of any certificate to such extent as may be necessary to protect the Owner from loss on account of:

(a)—Defective work not remedied;

(b)—Claims filed or reasonable evidence indicating probable filing of claims;

(c)—Failure of the Contractor to make payments properly to Subcontractors or for materials or labor;

(d)—A reasonable doubt that the Project can be completed for the unpaid balance of the Contract Price.

(e)—Damage to another Contractor or to some third party;

(f)—Failure to maintain a rate of progress in accordance with the currently approved construction progress schedule;

(g)—Failure to supply enough skilled workers or proper materials; or,

(h)—Failure to complete all Work within the Contract Time.

When the above grounds are removed, the Engineer shall issue to the Owner a certificate for such withheld amounts as he determines to be properly due, and the Owner shall pay such amounts within ten (10) days. At the option of the Owner adherence to the construction progress schedule shall be a condition precedent to the right of the Contractor to demand payment of a progress payment. No omission on the part of the Owner to exercise the aforesaid option shall be construed to be a waiver of breach of the construction progress schedule or acquiescence therein, and the Owner may exercise its option from time to time as often as may, in its judgment, be expedient.

Article 33. - Notice of Commencement.—See Notice to Proceed, as used throughout these General Conditions.

Article 34. - Correction of Work after Final Payment.—Neither (1) the final certificate, (2) or any decision of the Engineer, (3) nor payment, (4) nor any provision in the Contract shall relieve the Contractor of responsibility for faulty materials, faulty workmanship, or omission of Work required by the Contract Documents, and the Contractor shall remedy any defects or supply any omissions resulting therefrom and pay for any damage to other Work resulting therefrom. The Owner shall give notice of observed defects or omissions with reasonable promptness. The Contractor shall within the time designated in orders of condemnation and without expense to the Owner, correct, remedy, replace, re-execute, supply omitted Work, or remove from the premises all Work condemned by the Engineer. The Contractor shall give prompt notice in writing to the Engineer, with copy to the Owner, upon completion of the supplying of any omitted Work or the correction of any Work condemned by the Engineer. In the absence of said notice, it shall be and is presumed under this Contract that there has been no correction of the condemned Work or supplying of omitted Work. If the Contractor does not remove, make good the deficiency, correct, or remedy faulty Work, or supply any omitted Work within the time designated in orders of condemnation without expense to the Owner, the Owner, after ten (10) days' notice in writing to the Contractor, may remove the Work, correct the Work, remedy the Work or supply omitted Work at the expense of the Contractor. In case of emergency involving health, safety of property, or safety of life the Owner may proceed at once. Correction of defective Work executed under the Contract Documents

or supplying of omitted Work, whether or not covered by warranty of a Subcontractor or materialmen, remains the primary, direct responsibility of the Contractor. The foregoing obligation of the Contractor shall remain in effect until the same shall have been extinguished by operation of the statute of limitations.

As additional security for the fulfillment of such obligation, but in no way limiting the same, the Contractor warrants and guarantees (1) that all work executed under the Contract Documents shall be free from defects of materials or workmanship for a period of one year from the notice of final acceptance of the Work by the Owner, and (2) that for not less than one year from such final acceptance, or for such greater time as may have been designated in the Contract Documents, products of manufacturers shall be free from defects of materials and workmanship. Whenever written guaranties or warranties are called for, the Contractor shall furnish the aforesaid for such period of time as may be required. The aforesaid instruments shall be in such form as to permit direct enforcement by the Owner against any Subcontractor, materialmen, or manufacturer whose guaranty or warranty is called for, and the Contractor agrees that:

(a) The Contractor is jointly and severally liable with such Subcontractors, materialmen, or manufacturers;

(b) The said Subcontractors, materialmen, or manufacturers are agents of the Contractor for purposes of performance under this Article, and the Contractor, as principal, ratifies the warranties or guaranties of his aforesaid agents by the filing of the aforesaid instruments with the Owner. The Contractor as principal is liable for the acts or omissions of his agents;

(c) Service of notice on the Contractor that there has been breach of any warranty or guaranty will be sufficient to invoke the terms of the instrument; provided, however, that the Owner shall have furnished the Contractor with a copy of notice served on the Subcontractor, materialmen, or manufacturer; and,

(d) The Contractor will bind his Subcontractor, materialmen, and manufacturers to the terms of this Article.

The calling for or the furnishing of written warranties shall in no way limit the contractual obligation of the Contractor as set forth hereinabove. The remedies stated in this Article are in addition to the remedies otherwise available to the Owner, do not exclude such other remedies, and are without prejudice to any other remedies.

Article 35. - Cash Allowances.—The Contractor shall include in the Contract Price all cash allowances named in the Contract Documents and shall cause the Work thus covered to be done by such contractors or firms and for such sums as the Engineer may direct, the Contract Price being

adjusted in conformity therewith. The Contractor declares that the Contract Price includes such sums for overhead and profit on account of cash allowances as he deems proper. No demand for overhead and profit other than those included in the Contract Price shall be allowed. The Contractor shall not be required to employ for any such Work persons against whom he has a reasonable objection.

Article 36. – Contractor's Warranty as to Performance.—The Contractor warrants that it is familiar with the codes applicable to the Work and that it has the skill, knowledge, competence, organization, and plan to execute the Work promptly and efficiently in compliance with the requirements of the Contract Documents. The Contractor having the obligation to keep a competent superintendent engaged on the Work during its progress, to employ only skilled mechanics, and to enforce strict discipline and good order among its employees, the Contractor, itself, is responsible for seeing that the Work is installed in accordance with the Contract Documents. Failure or omission on the part of the Owner, representatives of the Owner, agents of the Owner, resident engineer inspector, clerk-of-the-works, engineers employed by the Engineer, representatives of the Engineer, or the Engineer either to discover or to bring to the attention of the Contractor any deviation from, omission from, or noncompliance with the Contract Documents shall not be asserted by the Contractor as a defense for failure on the Contractor's part to install the Work in accordance with the Contract Documents or for any other neglect to fulfill requirements of the Contract; nor shall the presence of any one, or all, or any of the foregoing at the site or the fact that any one, or all, or any of the foregoing may have examined the Work or any part of it be asserted as a defense by the Contractor against a claim for failure on its part to install the Work in accordance with the Contact Documents or for any neglect to fulfill requirements of the Contract. No requirement of this Contract may be altered or waived except in pursuance of a written order of the Owner and in strict accordance with the provisions in the Contract for changes in the Work.

Article 37. - Claims.—(a) *Extra Cost.*—If the Contractor maintains that any instructions by drawings or otherwise involve extra cost to the Owner under this Contract, the Contractor shall give the Owner and the Engineer written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute any change except in emergency endangering life or property. The allowances to the Contractor shall then be as provided under Article 29 of the General Conditions. No claim for extra cost shall be valid unless so made.

(b) *Protest.*—All references to arbitration are deleted from the Contract Documents. Decisions of the Engineer shall be rendered in all cases as provided for under the General Conditions of the Contract, but no decision of the Engineer shall deprive the Owner or the Contractor of any form of redress which may be available under the laws of the State of Georgia to contracting parties. Any decision of the Engineer shall be final and binding on the Contractor in the absence of written notice of protest from the Contractor received by the Owner by registered mail within twelve (12) days of the date of the decision of the Engineer. The Owner shall have twelve (12) days from the date of receipt of a protest within which to investigate and make a reply. There

is no provision under the Contract for execution of work "under protest". A protest must contain (1) the date of the decision of the Engineer to which exception is taken, (2) a statement of the issue or issues, (3) a citation of the provision or provisions of the Contract Documents which govern the issue or issues, (4) a summary of the logical principle or principles on which the protest is based, and (5) a summary of the legal grounds for taking exception. Filing a written notice of protest shall not be grounds for an extension of the Contract Time.

(c) *Shall be Based on the Legal Assertions of the Contractor.*—The Contractor shall assert claims solely on the basis of (a) principles of logic and (b) principles of law to which the Contractor, itself, has prescribed. The Contractor shall not protest a decision or request a conference on the ground merely that a Subcontractor, materialmen, or supplier has protested to the Contractor. Accordingly, the Contractor shall neither file a claim or make a request for a conference with the Owner regarding a claim except as it shall be for the purpose of asserting in the exercise of the Contractor's best judgment such views, requests, and legal propositions as he deems the Contractor is entitled to maintain independently of any right of any Subcontractor, materialmen, or supplier against the Contractor.

(d) *Conference with the Owner.*—

(1) *Effect of.*—The Owner has no legal obligation to confer orally with the Contractor about the terms of the Contract or its performance and may insist that all transactions and all intercourse shall be in writing. Agreement of the Owner to confer with a Contractor shall not be construed as an offer of the Owner to reconsider or alter the Owner's policies, practices, procedures, or prior position, and no such agreement shall constitute a waiver of any right or defense of the Owner. Such a conference is without prejudice to any rights or defense of the Owner. After the conference there will be nothing to confirm since the Owner does not engage itself to do or not to do a thing by agreeing to confer with the Contractor. It is expressly agreed that no conference between the Contractor and the Owner shall cure any failure of the Contractor to give any notice nor shall it cure any breach of any time limit or revive any right in the Contract.

(2) *Conditions precedent to.*—A proposal from the Contractor for a conference in respect to (a) a dispute, (b) a controversy, or (c) an interpretation or construction of any provision of the Contract Documents shall contain (a) a statement of the issue or issues, (b) a citation of the provisions of the Contract Documents which govern the issue or issues, (c) a precise summary of the logical principle or principles on which the issue or issues are based, and (d) a summary of the legal grounds which the Contractor takes with respect to the issue or issues.

(3) *Basis for and Terms of.*—All conferences between the Owner and the

Contractor shall be pursuant to, under the terms of, and in accordance with this Article of the General Conditions.

Article 38. - Use of Premises.—The Contractor shall confine its equipment, apparatus, the staging and storage of materials, the operations of its forces, and the Work to limits indicated by law, ordinances, permits, or the Contract Documents and shall not unreasonably encumber the premises with materials. The Contractor shall not load or permit any part of the Work to be loaded with weight that will endanger its safety. The Contractor shall enforce the Engineer's instructions regarding signs, advertisements, fires, and smoking.

Article 39. - Specification Arrangement.—The Specifications are separated into numbered and titled divisions for convenience of reference. Neither the Owner nor the Engineer assumes any responsibility for defining the limits of any subcontracts on account of the arrangement of the Specifications. Notwithstanding the appearance of such language in the various divisions of the Specifications as, "The Mechanical Contractor", "The Electrical Contractor", "The Roofing Contractor", etc., the Contractor is responsible to the Owner for the entire Contract and the execution of all of the Work referred to in the Contract Documents.

Article 40. - Valuable Material, Geological Specimens.—If during the execution of the Work the Contractor, any Subcontractor, or any servant, employee, or agent of either should uncover any valuable material or materials such as, but not limited to, treasure, geological specimen or specimens, archival material or materials, or ore, the Contractor acknowledges that title to the foregoing is vested in the Owner. The Contractor shall notify the Owner upon discovery of any of the foregoing, shall guard it, and shall deliver it promptly to the Owner. The Contractor agrees that the Geologic and Water Resources Division of the Georgia Department of Natural Resources may inspect the Work at reasonable times consistent with the convenience of the Contractor.

Article 41. - Definitions.—(a) *Applicable Law.*—This Contract shall be governed by the law of Georgia.

(b) *Article Not Plenary.*—This Article is not entire, plenary, or exhaustive of all terms used in the General Conditions which require definition. There are definitions of other terms under Articles to which the terms are related.

(c) *Balanced Bid.*—Balanced Bid shall mean a Bid in which each of the unit prices and total amount bid for each of the listed items reasonably reflects the value of that item with regard to the entire Project considering the prevailing cost of labor, material and equipment in the relevant market. A Bid is unbalanced when, in the opinion of the Owner, any unit prices or total amounts Bid on any of the listed items do not reasonably reflect such actual values.

(d) *Change Order Form.*—The Change Order Form is the instrument by which adjustments

in the Contract Price and Contract Time are effected pursuant to changes made in accordance with Case (a), Case (b) or Case (c) of Article 29 of the General Conditions or in accordance with Subparagraph (i) of Article 29 of the General Conditions. The Change Order Form shall be accompanied by a breakdown in the form prescribed in a specimen, which the Owner will supply to the Contractor. The Engineer shall certify to the amount of the adjustment. The Change Order Form shall be signed by the Contractor and the Owner. The breakdown is only for the purpose of enabling the Engineer and the Owner to make a judgment on the dollar amount of the adjustment in the Contract Price. No condition, term, qualification, limitation, exception, exemption, modification, or proviso shall appear in the breakdown. The breakdown shall be in the exact form and language of the above-mentioned specimen. In the event any condition, term, qualification, limitation, exception, exemption, modification, or proviso shall appear in a breakdown, it shall be invalid.

(e) *Contract; Contract Documents.*—The terms Contract and Contract Documents include the Invitation to Bid, Instructions to Bidders, Contractor's Bid (including all documentation accompanying the Bid and any post-Bid documentation required by the Owner prior to the Notice of Award), the Contract Agreement, Bonds, all Special Conditions, General Conditions, Supplementary Conditions, Specifications (Divisions 01 through 46, inclusive), Drawings, and Addenda, together with written amendments, Change Orders, field orders and the Engineer's written interpretations and clarifications issued in accordance with the General Conditions on or after the date of the Contract Agreement. Shop drawing submittals reviewed in accordance with the General Conditions, geotechnical investigations and soils reports, and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site are not Contract Documents.

(f) *Contract Time.*—Contract Time shall mean the number of consecutive calendar days as provided in the Contract Agreement for substantial completion of the Project, to be computed from and including the date of the Notice to Proceed. All time limits stated in the Contract Documents or shown on the construction progress schedule are of the essence of the Contract.

(g) *Contractor.*—The Contractor shall mean the party identified in the Contract Agreement and its authorized and legal representatives.

(h) *Cross-reference and Citations of Articles and Paragraphs of the General Conditions.*—Cross-references and citations of Articles and paragraphs of the General Conditions are for the convenience of the Contractor, Engineer and the Owner, and are not intended to be plenary or exhaustive nor are they to be considered in interpreting the Contract Documents or any part of the Contract Documents.

(i) *Engineer.*—The Engineer shall mean Clark Nexsen, Inc.

(j) *Furnished by Owner.*—Furnished by Owner shall mean that the Owner shall pre-purchase specific products and have them delivered to a place mutually agreed upon by the supplier, the Owner and the Contractor, at no cost to the Contractor. In connection with an item furnished by the Owner, "Install" shall mean to take delivery of the item, off-load and transport to the job site, store as necessary and install according to the Drawings and Specifications.

(k) *Install, Deliver, Furnish, Supply, Provide.*—Such words mean the work in question shall be put in place by the Contractor ready for occupancy and use, unless expressly provided to the contrary.

(l) *Liquidated Damages.*—Liquidated Damages shall mean the sum stated in the Contract Agreement which the Contractor agrees to pay for each consecutive calendar day beyond the Contract Time required to achieve substantial completion of the Project. Liquidated Damages will end upon written notification from the Owner that the Project is ready for initiation of the Operating Test Period for the total Project.

(m) *Meaning of words and phrases.*—Unless the context or the Contract Documents taken as a whole indicate to the contrary, words used in the Contract Documents that have usual and common meanings shall be given their usual and common meanings and words having technical or trade meanings shall be given their customary meaning in the subject business, trade or profession.

(n) *Notices.*—Unless otherwise provided in the Contract Documents, written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered or sent by certified mail to the last business address known to the party that gives notice.

(o) *Notice to Proceed.*—The Notice to Proceed is a written notice from the Owner pursuant to which the Contractor shall commence physical work on the Project site. A Notice to Proceed is a condition precedent to the execution of any Work on the site by the Contractor.

(p) *Order of Condemnation.*—An Order of Condemnation shall be in writing, shall be dated, shall be signed by the Engineer, shall be addressed to the Contractor with a copy to the Owner, and shall contain three elements as follows:

FIRST ELEMENT: Description of Work

(1) which has been omitted or
(2) which is unexecuted as of the date of the Order of Condemnation, the time for its incorporation into the Work under the construction progress schedule having expired, or
(3) which has not been executed in accordance with the methods and materials

designated in the Contract Documents.

SECOND ELEMENT: Citation of the provision or provisions of the Contract Documents which has or have been violated.

THIRD ELEMENT: Fixing of a reasonable time within which the Contractor shall have made good or remedied the deficiency which said time shall not be deemed to be an extension of Contract Time or deemed to be authorization for amendment to the construction progress schedule.

An Order of Condemnation may be issued for failure of the Contractor to supply enough workers or enough materials or proper materials, the Order of Condemnation in such event being based on Article 28 of the General Conditions and upon the definition of Work as set forth under Article 41(u).

(q) *Owner.*—The Owner shall mean THE MACON WATER AUTHORITY or its authorized and legal representatives.

(r) *Products.*—Products shall mean materials or equipment permanently incorporated into the Work.

(s) *Specifications.*—The term "Specifications" shall include all written matter in the bound volume (Divisions 01 through 46, inclusive) or on the drawings and any addenda or modifications thereto.

(t) *Subcontractor.*—The term Subcontractor as employed herein includes only those having a direct contract with the Contractor. It includes one who furnishes labor and materials which are incorporated into the Work but does not include one who merely furnished materials incorporated into the Work by the labor of others.

(u) *Work; Project.*—The terms Work and Project shall mean the entire completed construction required to be furnished under the Contract Documents.

END OF SECTION

SECTION 00800

SUPPLEMENTARY CONDITIONS

GENERAL (Example, if any conditions exist)

The provisions in these Supplementary Conditions shall govern in the event of any conflict between the General Conditions and the provisions herein.

Policy "A". – Compaction Tests and Shop Drawing Submittals

Please contact Mr. Joel Herndon, the Macon Water Authority's (the "Owner's) Chief Inspector, at 478.464.5639 before commencing the construction activity. Compaction tests, where required, shall be performed in accordance with Macon Water Authority's policy. The Contractor and the soil testing laboratory shall contact Mr. Herndon before the testing. The location at which the tests are performed will be decided by our inspection crew. The test report shall be submitted to the Engineering Division before the Owner can accept the Project for operation and maintenance. The Contractor shall submit five (5) copies of the shop drawings (ductile iron pipe, gate valve, valve box, ductile iron fittings, fire hydrant, manholes, manhole frames and covers, gravity sewer pipe, support structures, appurtenances, etc.) before installation. The Contractor will not be permitted to install materials and appurtenances until all the shop drawings are approved. The Contractor shall submit two copies of as-built drawings after the completion of construction but before the Project is accepted for operation and maintenance. The as-built drawings shall include the following for water/sewer portion of the Project: location of water main, valves, fire hydrants, fittings, water services to each lot, location of sewer mains, manholes (including rim and invert elevations), distance and angle between manholes, distance and length of each lateral from manholes, location of water main, gate valves, fire hydrants and fittings, width of easements and any other pertinent information.

Note: See Section 01720 for additional requirements.

Policy "B". – Televising: NOT USED

Policy "C". – As-Builts: Produce and submit "AS-BUILT" survey of the generator, electrical lines to and from transfer switch, and any other underground utilities that were encountered during the installation. As-Builts shall be prepared by a licensed Professional Engineer or Georgia Registered Land Surveyor, as appropriate for the project, and shall be submitted before the project is accepted by the Owner for operation and maintenance and before any project plat is signed.

The As-Built drawings shall be submitted in either the (.dxf) or the (.dwg) version DWG 2010 or later on a USB Flash Drive, along with two (2) sets of plans in the same format as shown on the drive. The As-Built drawings shall be submitted on a (24" x 36") sheet. The vertical and horizontal accuracy of the as-builts shall be within 0.1-foot accuracy.

All relative information such as right-of-way, property corners, state plane monuments, etc. shall be located and tied to Georgia State Plane Coordinates.

Policy "D" – Payment Estimate Form – The Contractor shall generate an EXCEL spreadsheet listing all items in the Proposal and columns for quantities this period, total this period, total quantities to date, and total amount to date for a detail backup for the attached pay estimate summary sheet.

MWA PAY ESTIMATE FORM – FOLLOWS ON SEPARATE PAGE

- **Project Milestone & Scheduling**- It is the desire of the Owner to complete this Project within the Contract Time allocated in the Contract Documents.

END OF SECTION

Macon Water Authority

Material Pick-up Acknowledgement

Macon Water Authority
537 Hemlock St. P.O. Box 108
Macon GA 31202
Phone: (478) 464–5600
Fax: (478) 738-3864

Project Name: _____

Project Engineer: _____

Project Manager: _____

Itemized List of the Materials:

Material Description	Size (if applicable)	Length (if applicable)	Quantity

I understand and acknowledge by receipt of the Materials listed, that:

These Materials furnished by the Macon Water Authority have been inspected thoroughly by me prior to transport to the project location; and that Materials in transport to the project location become the sole responsibility of my company.

_____
(Print Contractor's Company Name)

By:_____
(**Signature** of Authorized Representative - *person picking up the materials*)

Date: _____

Print Name: _____

By: _____ Date: _____
MWA-Warehouse Manager or MWA-Authorized Representative

Macon Water Authority

PAY ESTIMATE

Summary Sheet

Macon Water Authority
537 Hemlock St. P.O. Box 108
Macon GA 31202
Phone: (478) 464–5600
Fax: (478) 738-3864

Project Name: _____

MWA's Project Number: _____

Pay Estimate Number: _____ Partial: _____

Final: _____

Pay Period: _____

Original Contract Amount: $_____

Total Change Orders to Date: _____

Current Contract Amount: $_____

Original contract Work Performed to Date: _____

Change Order Work Performed to Date: _____

Materials Stored on Job Site: _____

Subtotal: _____

Less (5 %) Previous Retainage: _____

Subtotal: _____

Less Previous Payments: _____

Current Invoice Amount: _____

Less (5 %) Current Retainage: _____

Balance Due This Payment: _____

According to the best of my knowledge and belief, all items and amounts shown on the face of this Pay Estimate are correct; that all Work has been performed or materials supplied, or both, in full accordance with the requirements of the Contract Documents, or duly authorized deviations or additions thereto; that the foregoing is a true and correct statement of the Contract Price account up to and including the last day of the period covered by this Pay Estimate; that none of the "Balance Due This Payment" has been received, and that the undersigned and its Subcontractors have complied with all the labor provisions of the Contract Documents.

The Contractor further certifies that on those items of Work not disputed that all payables, materials, bills, and other indebtedness connected with the Work have been paid (less retention equal to that being retained by the Owner) for Work covered by previous payments. Quantities on request for partial payment are estimated only. Final quantities are by a final survey and "as built" drawings by Contractor.

_____ By:_____
(Contractor's Company Name-PRINT) (Signature of Contractor's Authorized Representative)

Date: _____ Title: _____

By: _____ By: _____ By: _____
MWA-Inspector Project Engineer MWA-Project Manager

Date: _____ Date: _____ Date: _____

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Contractor's use of site and premises.
6. Work restrictions.
7. Specification and Drawing conventions.
8. Miscellaneous provisions.

1.3 DEFINITIONS

A. Work Package: A group of specifications, and drawings prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Replace 4160v Gear and MCC at Lower Poplar WWTP.

1. Project Location: 1101 Lower Poplar St., Blower Building, Macon, Georgia.

B. Owner: Macon Water Authority, 537 Hemlock Street, Macon, Georgia 31201.

C. Owner's Representative: Heather Veal, (478) 464-5600.

D. Architect: Clark Nexsen, (478) 743-8415.

1. Architect's Representative: Blake Cummings.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Removal and Replacement of existing 4160v Gear and Motor Control Center.

2. Removal and replacement of existing controls.

3. Removal and replacement of selective HVAC equipment.

4. Miscellaneous Architectural improvements to include cleaning, painting and screen installation.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 PHASED CONSTRUCTION

A. Construct the Work in phases, work shall be phased and completed so that existing blowers are active at all times. Down time shall be limited and scheduled with MWA prior to beginning work.

B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule, showing the sequence, commencement and completion dates for all phases of the Work.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Driveways, Walkways and Entrances: Keep driveways loading areas**,** and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on the use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by the Owner and authorities having jurisdiction.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than three days in advance of proposed utility interruptions.

D. Smoking and Controlled Substance Restrictions: Use of tobacco products and other controlled substances on Owner's property is not permitted.

E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 30 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.

d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.
g. Scheduled dates for purchasing.
h. Scheduled date of fabrication.
i. Scheduled dates for installation.
j. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
5. Category and type of submittal.
6. Submittal purpose and description.
7. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
8. Drawing number and detail references, as appropriate.
9. Indication of full or partial submittal.
10. Location(s) where product is to be installed, as appropriate.
11. Other necessary identification.
12. Remarks.
13. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

F. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

G. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.

2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

    1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.8 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

    1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action**.**

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

1.9 ARCHITECT'S AND CONSTRUCTION MANAGER'S REVIEW

A. Action Submittals: Architect and Construction Manager will review each submittal, indicate corrections or revisions required.

1. PDF Submittals: Architect and Construction Manager will indicate, via markup on each submittal, the appropriate action**.**

B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect and Construction Manager will **return without review discard** submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.

10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first listed by room or space number.

2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel Electronic File: Architect, through Construction Manager, will return annotated file.
    b. PDF Electronic File: Architect, through Construction Manager, will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

    1. Submit on digital media acceptable to Architect.

E. Warranties in Paper Form:

    1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
    2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
    3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.

k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils.

1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.

q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in of Macon Water Authority.

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Review and finalize protection requirements.
7. Review procedures for noise control and dust control.
8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Survey of Existing Conditions: Submit survey.

D. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property**,** for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

E. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.

a. Hazardous materials will be removed by Owner before start of the Work.
b. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. On-site sale of removed items or materials is not permitted.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

D. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
4. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.

5. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.

    a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    b. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

6. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:

    a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
    b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 8hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" to mean historic "removal" or "dismantling" as specified in Section 024296 "Historic Removal and Dismantling."

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:

1. Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
2. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive in accordance with recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 042113 “Brick Masonry” for ties and anchors as a part of that exterior wall system.

C. Section 072100 “Thermal Insulation” for insulation and ties and anchors as a part of that exterior wall system.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Embedded flashing.
6. Miscellaneous masonry accessories.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with NCSBC Section 2105.2.2.1.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing

agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

D. Samples for Initial Selection:

1. Colored mortar.

1.7 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength,

ASTM C 1506 for water retention, and ASTM C 91 for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements. Integral water repellant: Detailed descriptions material and letter from manufacturer of Concrete Masonry Units confirming compatibility with their product.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

C. ng jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as

manufactured, within 500 miles of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

C. CMUs: ASTM C 90.

1. Density Classification: Lightweight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.3 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cemex S.A.B. de C.V.; Dixie Type S.
b. Essroc, Italcementi Group; Brixment.
c. Holcim (US) Inc.; Mortamix Masonry Cement.
d. Lafarge North America Inc.; Lafarge Masonry Cement.
e. Lehigh Cement Company; Lehigh Masonry Cement.

C. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Aggregate for Grout: ASTM C 404.

E. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

F. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units. Basis of design for exterior walls with brick veneer: Hohman & Barnard, Inc 165 Adjustable Truss. Additional acceptable manufacturers include Durawall and Wire-Bond
8. Basis of design for exterior walls with rubble stone: Hohman & Barnard, Inc Tie-HVR-195V Anchor System. Additional acceptable manufacturers include Durawall and Wire-Bond

2.6 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch**.**

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
2) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.

3) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
4) Hohmann & Barnard, Inc.; Textroflash.
5) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

B. Drip Edge: No drip edge will be used at termination of flashing at brick veneer. Flexible flashing provided must be able to be used without a drip edge.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is fully concealed, use flexible flashing.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use masonry cement mortar.
4. For reinforced masonry, use masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.

4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. sible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.

2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, lintels and sills, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge either tucked under building air barrier or overlapping building air barrier, as required by air barrier manufacturer, lapping at least 4 inches.
3. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Install metal drip edges or flashing beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge. Rubberized asphalt flashing may not be permanently exposed to the weather.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 48 inches.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to the Statement of Special Inspections

1. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
2. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

H. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. lication, where indicated.

D. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

E. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic

scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 1 inch in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Concrete face brick.
3. Mortar materials.
4. Ties and anchors.
5. Embedded flashing.
6. Accessories.
7. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection:

1. Clay face brick.
2. Colored mortar.

C. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.4 INFORMATIONAL SUBMITTALS

A. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units from single source.

B. For cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

2.3 BRICK

A. Regional Materials: Brick shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

   a.

2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 ft. or have a history of successful use in Project's area.
5. Size (Actual Dimensions): 3-1/2 inches wide by 2-1/4 inches high by 7-5/8 inches long.
6. Where shown to "match existing," provide clay face brick matching color range, texture, and size of existing adjacent brickwork.
7. Grade: SW

8. Type: FBS

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

D. Colored Cement Products: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Masonry Cement:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Argos USA LLC
2) Cemex S.A.B. de C.V.
3) Fairborn Cement Company
4) Holcim (US) Inc
5) Lafarge North America Inc.
6) Lehigh Hanson; HeidelbergCement Group

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments do not exceed 5 percent of masonry cement by weight.

E. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

2.5 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.

C. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0785-inch- thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized steel wire unless otherwise indicated.
4. Masonry-Veneer Anchors: L shaped plate section with ribs for added strength, and holes for connecting fastener. Eyelets allow for pintle with w insertions. Horizontal length sized for specified thickness of insulation.
    a. Basis-of-Design Product: Subject to compliance with requirements, provide HB-213 and HB-5213 depending on backup materials, or comparable product by one of the following:
        1) Heckmann Building Products, Inc.
        2) Hohmann & Barnard, Inc
        3) PROSOCO, Inc
        4) Rodenhouse Inc.
        5) Wire-Bond

2.6 EMBEDDED FLASHING

A. Flexible Flashing: Use the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 30 mil.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
        2) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
        3) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing. Basis of Design
        4) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
        5) Hohmann & Barnard, Inc.; Textroflash.
        6) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
        7) Polyguard Products, Inc.
    b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

C. Drip Edge: No drip edge will be used at termination of flashing at veneer. Flexible flashing provided must be able to be used without a drip edge.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:

1) QV Quadro-Vent Jumbo 3/8-inch thick by 3 3/8-inches wide x 3 ½-inch tall as manufactured by Hohmann and Barnard, Inc.
2) Dayton Superior Corporation, Dur-O-Wall Division, Cell Vents
3) Heckman Building Products Inc., No. 85 Cell Vent

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Rainscreen Drainage Mat: Sheets or strips not less than full depth of cavity thick and installed to full height of cavity, to prevent weep holes from clogging with mortar.

a. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:

1) Mortar Net, Mortar Net USA, Ltd. (BASIS OF DESIGN)
2) Mortar Break II, Advanced Building Products, Inc.
3) Dayton Superior Corporation, Dur-O-Wall Division, Polytite Mortar Stop

D. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.; a Hohmann & Barnard company

b. EaCo Chem, Inc.
c. PROSOCO, Inc

2.8 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.

C. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. , 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns,

and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Lay hollow brick with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

B. Provide not less than dimension indicated on drawings of airspace between back of masonry veneer and face of sheathing.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:

1. Build in compressible joint fillers where indicated.
2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide offset angle supports where indicate and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches.
3. At lintels and shelf angles, extend flashing 6 inches minimum at each end. At heads and sills, extend flashing 6 inches minimum and turn ends up not less than 2 inches to form end dams.
4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.

5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
6. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches o.c. unless otherwise indicated.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.11 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042613

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 042113 “Brick Masonry” for ties and anchors as a part of that exterior wall system.

C. Section 072100 “Thermal Insulation” for insulation and ties and anchors as a part of that exterior wall system.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Embedded flashing.
6. Miscellaneous masonry accessories.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with NCSBC Section 2105.2.2.1.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing

agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

D. Samples for Initial Selection:

1. Colored mortar.

1.7 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength,

ASTM C 1506 for water retention, and ASTM C 91 for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements. Integral water repellant: Detailed descriptions material and letter from manufacturer of Concrete Masonry Units confirming compatibility with their product.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

C. ng jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as

manufactured, within 500 miles of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

C. CMUs: ASTM C 90.

1. Density Classification: Lightweight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.3 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cemex S.A.B. de C.V.; Dixie Type S.
b. Essroc, Italcementi Group; Brixment.
c. Holcim (US) Inc.; Mortamix Masonry Cement.
d. Lafarge North America Inc.; Lafarge Masonry Cement.
e. Lehigh Cement Company; Lehigh Masonry Cement.

C. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Aggregate for Grout: ASTM C 404.

E. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

F. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units. Basis of design for exterior walls with brick veneer: Hohman & Barnard, Inc 165 Adjustable Truss. Additional acceptable manufacturers include Durawall and Wire-Bond
8. Basis of design for exterior walls with rubble stone: Hohman & Barnard, Inc Tie-HVR-195V Anchor System. Additional acceptable manufacturers include Durawall and Wire-Bond

2.6 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch**.**

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
2) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.

3) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
4) Hohmann & Barnard, Inc.; Textroflash.
5) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

B. Drip Edge: No drip edge will be used at termination of flashing at brick veneer. Flexible flashing provided must be able to be used without a drip edge.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is fully concealed, use flexible flashing.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use masonry cement mortar.
4. For reinforced masonry, use masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.

4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. sible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.

2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, lintels and sills, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge either tucked under building air barrier or overlapping building air barrier, as required by air barrier manufacturer, lapping at least 4 inches.
3. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Install metal drip edges or flashing beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge. Rubberized asphalt flashing may not be permanently exposed to the weather.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 48 inches.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to the Statement of Special Inspections

1. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
2. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

H. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. lication, where indicated.

D. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

E. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic

scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 1 inch in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Concrete face brick.
3. Mortar materials.
4. Ties and anchors.
5. Embedded flashing.
6. Accessories.
7. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection:

1. Clay face brick.
2. Colored mortar.

C. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.4 INFORMATIONAL SUBMITTALS

A. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements

contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units from single source.

B. For cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

2.3 BRICK

A. Regional Materials: Brick shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

   a.

2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 ft. or have a history of successful use in Project's area.
5. Size (Actual Dimensions): 3-1/2 inches wide by 2-1/4 inches high by 7-5/8 inches long.

6. Where shown to "match existing," provide clay face brick matching color range, texture, and size of existing adjacent brickwork.
7. Grade: SW
8. Type: FBS

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

D. Colored Cement Products: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Masonry Cement:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Argos USA LLC
2) Cemex S.A.B. de C.V.
3) Fairborn Cement Company
4) Holcim (US) Inc
5) Lafarge North America Inc.
6) Lehigh Hanson; HeidelbergCement Group

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments do not exceed 5 percent of masonry cement by weight.

E. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

2.5 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a

5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.

C. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0785-inch- thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized steel wire unless otherwise indicated.
4. Masonry-Veneer Anchors: L shaped plate section with ribs for added strength, and holes for connecting fastener. Eyelets allow for pintle with w insertions. Horizontal length sized for specified thickness of insulation.
    a. Basis-of-Design Product: Subject to compliance with requirements, provide HB-213 and HB-5213 depending on backup materials, or comparable product by one of the following:
        1) Heckmann Building Products, Inc.
        2) Hohmann & Barnard, Inc
        3) PROSOCO, Inc
        4) Rodenhouse Inc.
        5) Wire-Bond

2.6 EMBEDDED FLASHING

A. Flexible Flashing: Use the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 30 mil.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
        2) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
        3) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing. Basis of Design
        4) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.

5) Hohmann & Barnard, Inc.; Textroflash.
6) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
7) Polyguard Products, Inc.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

C. Drip Edge: No drip edge will be used at termination of flashing at veneer. Flexible flashing provided must be able to be used without a drip edge.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:

1) QV Quadro-Vent Jumbo 3/8-inch thick by 3 3/8-inches wide x 3 ½-inch tall as manufactured by Hohmann and Barnard, Inc.
2) Dayton Superior Corporation, Dur-O-Wall Division, Cell Vents
3) Heckman Building Products Inc., No. 85 Cell Vent

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Rainscreen Drainage Mat: Sheets or strips not less than full depth of cavity thick and installed to full height of cavity, to prevent weep holes from clogging with mortar.

a. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:

1) Mortar Net, Mortar Net USA, Ltd. (BASIS OF DESIGN)
2) Mortar Break II, Advanced Building Products, Inc.
3) Dayton Superior Corporation, Dur-O-Wall Division, Polytite Mortar Stop

D. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction

stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Diedrich Technologies, Inc.; a Hohmann & Barnard company
    b. EaCo Chem, Inc.
    c. PROSOCO, Inc

2.8 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.

C. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. , 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus

or minus 1/8 inch.

5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Lay hollow brick with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall

area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

B. Provide not less than dimension indicated on drawings of airspace between back of masonry veneer and face of sheathing.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:

1. Build in compressible joint fillers where indicated.
2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide offset angle supports where indicate and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as

recommended by flashing manufacturer.

2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches.
3. At lintels and shelf angles, extend flashing 6 inches minimum at each end. At heads and sills, extend flashing 6 inches minimum and turn ends up not less than 2 inches to form end dams.
4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
6. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches o.c. unless otherwise indicated.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic

scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.11 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042613

SECTION 089116 - OPERABLE WALL LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Operable, extruded-aluminum louvers.

1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include isometrics, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.
3. Wiring Diagrams: For power, signal, and control wiring for motorized operable louvers.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturer's special warranties.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain operable louvers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures to the face of the building are considered to act normal.

1. Wind Loads:

a. Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.

B. Louver Performance Ratings: Provide louvers complying with requirements indicated on drawings, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

2.3 OPERABLE EXTRUDED-ALUMINUM LOUVERS

A. Louver Construction and Operation: Provide operable louvers with extruded-aluminum

frames and blades of not less than 0.080-inch nominal thickness, and with operating mechanisms to suit louver sizes.

1. Motor operation with two-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch; equipped with terminals for controlling devices.

B. Operable, Extruded-Aluminum, Dual-Blade Louver : Fixed drainable blades and operable plain blades combined in single frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Arrow United Industries; Mestek, Inc.
    b. Greenheck Fan Corporation
    c. NCA Manufacturing, Inc.; Metal Industries, Inc.
    d. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
    e. United Enertech Corp.
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
    a. Greenheck Fan Corporation, Model No. EAC-601
3. Louver Depth: 6 inches, overall.
4. Louver Performance Ratings:
    a. Free Area: Not less than 45 percent of total area.
    b. Point of Beginning Water Penetration: Not less than 900 fpm.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location: Interiorface unless otherwise indicated.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless steel machine screws or machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
2. Finish: Same finish as louver frames to which louver screens are attached or Mill finish.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening, Aluminum: 1/2-inch square mesh, 0.063-inch wire.
2. Bird Screening, Flattened, Expanded Aluminum: 3/4 by 0.050 inch thick.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless steel components, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing in accordance with ASTM E488/E488M conducted by a qualified testing agency.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Exterior flange unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Follow manufacturer recommendations for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089116

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation of interior substrates and application of the following:

1. Primers.
2. Water-based finish coatings.
3. Floor sealers and paints.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat. Submit actual paint drawdowns as specified below for verification Samples.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in applicable interior painting schedule articles to cross-reference paint systems specified in this Section. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each paint product from single source from single manufacturer.

2.2 INTERIOR PAINTS, GENERAL

A. Interior Paints: Subject to compliance with requirements, provide product listed in product types below and applicable interior painting schedule articles for the paint category indicated.

B. Material Compatibility:

1. Materials for use within each paint system must be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

C. Material Emissions and Pollutant Control: Verify not less than 85 percent of field-applied paints and coatings that are inside the weatherproofing system comply with either of the following:

1. Low-Emitting Materials: Verify VOC emissions comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
2. Verify VOC content does not exceed limits of authorities having jurisdiction and the following:

a. Flat Coatings: 50 g/L.
b. Nonflat Coatings: 100 g/L.
c. Nonflat - High-Gloss Coatings: 150 g/L.
d. Concrete/Masonry Sealers: 100 g/L.
e. Floor Coatings: 100 g/L.
f. Industrial Maintenance Coatings: 250 g/L.
g. Low-Solids Coatings: 120 g/L.
h. Mastic Texture Coatings: 100 g/L.
i. Metallic Pigmented Coatings: 500 g/L.
j. Pretreatment Wash Primers: 420 g/L.

k. Primers, Sealers, and Undercoaters: 100 g/L.
l. Reactive Penetrating Sealers: 350 g/L.
m. Recycled Coatings: 250 g/L.
n. Rust-Preventive Coatings: 250 g/L.

D. Colors: As selected by Architect from manufacturer's full range

2.3 PRIMERS

A. Latex Block Filler: Water-based, pigmented, high-solids, emulsion coating formulated to bridge and fill porous surfaces of CMU substrates in preparation for specified subsequent coatings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. PPG Paints; PPG Industries, Inc.
d. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
e. Sherwin-Williams Company (The)
f. Valspar; a brand of The Sherwin-Williams Company

B. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. McCormick Paints
d. PPG Paints; PPG Industries, Inc.
e. Rodda Paint Co.
f. Sherwin-Williams Company (The)

2.4 WATER-BASED FINISH COATINGS

A. Interior Latex Paint: Pigmented, water-based coating for use on interior primed/sealed plaster and gypsum board, and on primed wood and metals.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. Coronado Paint; Benjamin Moore & Co.
d. Insl-X Products; Benjamin Moore & Co.
e. McCormick Paints
f. PPG Paints; PPG Industries, Inc.
g. Rodda Paint Co.

h. Sherwin-Williams Company (The)
i. Valspar; a brand of The Sherwin-Williams Company

2. Gloss and Sheen Level: Satin for walls, Flat for ceilings.

B. Interior, High-Performance Architectural Latex: Water-based, pigmented, low-VOC, emulsion coating formulated to provide a significantly higher level of performance than conventional latex paints in the areas of scrub resistance, burnish resistance, and ease of stain removal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. PPG Paints; PPG Industries, Inc.
d. Rodda Paint Co.
e. Sherwin-Williams Company (The)

2. Gloss and Sheen Level: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Cementitious Composition Board: 12 percent.
3. Masonry (Clay and CMU): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent. Verify that finishing compound is dry and sanded smooth.
6. Plaster: 12 percent. Verify that plaster is fully cured.

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer.]

G. Galvanized Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove loose surface oxidation.

I. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for interior use in paint system indicated.
2. Sand surfaces that will be exposed to view and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Canvas and Cotton Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION OF INTERIOR PAINT PRODUCTS

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in the applicable interior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view in equipment rooms:

    a. Equipment, including panelboards and switch gear.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE, CONCRETE SUBSTRATES

A. Nontraffic Surfaces:

1. Latex System :

a. Prime Coat: Matching topcoat.
b. Topcoat: Interior latex paint
c. Location and Sheen: Satin for walls, Flat for ceiling

B. Horizontal (Traffic) Surfaces:

1. Latex Floor Enamel System :

a. Prime Coat: Matching topcoat.
b. Topcoat: Latex floor enamel, low gloss.

3.7 INTERIOR PAINTING SCHEDULE, MASONRY SUBSTRATES

A. CMU Substrates:

1. Latex System :

a. Block Filler: Interior/exterior latex block filler.
b. Topcoat: Interior latex paint, satin.

3.8 INTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

A. Steel and Iron Substrates:

1. High-Performance Architectural Latex System :

a. Prime Coat: Alkyd metal primer.
b. Topcoat: Topcoat: Interior, high-performance architectural latex, semigloss.
c. Location: handrails and exposed structure.

END OF SECTION 099123

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Silicone sealants.

B. Related Requirements:

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence. Refer to electrical drawings for those characteristics.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.
5. Comply with UL 674 and UL 1203 for explosion proof motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft**.** above sea level.

C. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with

indicated operating sequence, and without exceeding nameplate ratings or considering service factor. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Rotor: Random-wound, squirrel cage.
5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating.
7. Insulation: Class B.
8. Code Letter Designation:
    a. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.
9. Enclosure Material: Rolled steel for motor frame sizes smaller than 324T.

D. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.
2. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
3. Motors 1/20 hp and Smaller: Shaded-pole type.
4. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

2.2 SEALANTS

A. Silicone Sealants:

1. Silicone Sealant, S, P, T, NT: Single-component, , pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
    a. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

PART 3 - EXECUTION

3.1 INSTALLATION OF SILICONE SEALANT

A. Install Sealant in accordance with manufacturer instructions and recommendations.

END OF SECTION 230500

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's unique equipment mark number.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting

of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS

A. Permanently fasten labels on each item of mechanical equipment.

B. Sign and Label Colors:

1. White letters on a black background.

C. Locate equipment labels where accessible and visible.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:

a. Constant-volume air systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

G. UFAD: Underfloor air distribution.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.

C. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.5 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, to verify that these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine equipment performance data, including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

E. Examine HVAC equipment and verify that bearings are greased and equipment with functioning controls is ready for operation.

F. Examine operating safety interlocks and controls on HVAC equipment.

G. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

H. Report deficiencies discovered before and during performance of TAB procedures.

Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
    a. Volume dampers are open and functional.
    b. Fans are operating, free of vibration, and rotating in correct direction.
    c. Automatic temperature-control systems are operational.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Fans and ventilators.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for fans. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Check airflow patterns from the outdoor-air louvers and dampers and verify proper operation.

C. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

D. Verify that motor starters are equipped with properly sized thermal protection.

E. Check dampers for proper position to achieve desired airflow path.

F. Check for airflow blockages.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
    a. Where conditions are unsuitable for Pitot-tube traverse measurements, a velocity grid may be used to determine the average airflow through an opening of known size.
2. Measure fan static pressures as follows:
    a. Measure static pressure directly at the fan inlet.

B. Verify final system conditions.

1. Re-measure and confirm that minimum airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Measure and record all operating data.
6. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

3.8 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Verify that controllers are calibrated and function as intended.
3. Verify that controller set points are as indicated.
4. Verify that controlled devices are properly installed and connected to correct controller.
5. Verify location and installation of sensors to ensure that they sense only intended temperature.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.9 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Exhaust Fans: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.

D. Electric-Coil Test Reports: For electric unit heaters, include the following:

1. Unit Data:

    a. Equipment identification.

b. Capacity in Btu/hBtu/h (kW).
c. Number of stages.
d. Connected volts, phase, and hertz.
e. Rated amperage.
f. Airflow rate in cfmcfm (L/s).

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/hBtu/h (kW).
b. Airflow rate in cfmcfm (L/s).
c. Entering-air temperature in deg Fdeg F (deg C).
d. Leaving-air temperature in deg Fdeg F (deg C).
e. Voltage at each connection.
f. Amperage for each phase.

E. Fan Test Reports: For exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

F. Rectangular Duct Traverse Reports: Record the following:

1. Report Data:

a. System fan.
b. Location and zone.
c. Duct static pressure in inches wg.
d. Duct size in inches.
e. Duct area in sq. ft..
f. Indicated airflow rate in cfm.
g. Indicated velocity in fpm.
h. Actual airflow rate in cfm.
i. Actual average velocity in fpm.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION 230593

SECTION 233400 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fans, propeller - sidewall mounted.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
b. Rated capacities, furnished specialties, and accessories for each fan.
c. Fans:

1) Certified fan performance curves with system operating conditions indicated.
2) Certified fan sound-power ratings.
3) Fan construction and accessories.
4) Motor ratings and electrical characteristics, plus motor and electrical accessories.
5) Fan speed controllers.

d. Material thickness and finishes, including color charts.
e. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include sections and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fans and ventilators, include the following:

1. Operation and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective coverage for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. Capacities and Characteristics:

1. Housing Material: Reinforced steel.
2. Housing Coating: Epoxyor Powder-baked enamel.
3. Wheel Material: Aluminum.
4. Motor:
    a. Motor Enclosure: Open, dripproof or Totally enclosed, fan cooled.

2.2 FANS, PROPELLER - SIDEWALL MOUNTED

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corp.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Carnes Company
4. Greenheck.
5. JencoFan
6. Loren Cook Company
7. PennBarry; division of Air System Components

B. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck; Model BAER-30 or comparable product by one of the following:

C. Standards: Comply with UL 705.

D. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring, with baked-enamel finish coat applied after assembly.

E. Fan Wheel: Replaceable, **cast** or **extruded**-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

F. Fan Drive, Belt:

1. Belt drive.
2. Resiliently mounted to housing.
3. Statically and dynamically balanced.
4. Selected for continuous operation at maximum-rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
5. Extend grease fitting to accessible location outside of unit.
6. Service Factor Based on Fan Motor Size: 1.4.
7. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
8. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

    a. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.

9. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
10. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
11. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

G. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Dampers: Counterbalanced, parallel-blade, backdraft dampers factory set to close when fan stops.
3. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
4. Wall Sleeve: Galvanized steel to match fan and accessory size.
5. Weathershield Hood: Galvanized steel to match fan and accessory size.
6. Weathershield Front Guard: Galvanized steel with expanded metal screen.
7. Belt Guard: For motor mounted on outside of fan cabinet. Comply with OSHA and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; 0.146-inch-thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short-circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."

2.4 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.

B. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

C. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Support duct-mounted and other hanging fans directly from the building structure or masonry walls.

E. Unit Support: Coordinate wall penetrations and flashing with wall construction.

1. Comply with requirements in Section 230548.13 "Vibration Controls for HVAC."

F. Install units with adequate clearances for service and maintenance.

G. Label fans in accordance with requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.3 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.5 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

END OF SECTION 233400

SECTION 238239.16 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Propeller unit heaters with electric-resistance heating coils.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
4. Indicate location and arrangement of integral controls.
5. Wiring Diagrams: Power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Airtherm; a Mestek company
2. QMark
3. Marley
4. Modine
5. Reznor
6. Markel/TPI

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. QMark Model MUH

C. Heaters: Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with UL 2021.

2.2 PERFORMANCE REQUIREMENTS

A. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.3 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

B. Discharge Louver: Adjustable fin diffuser for horizontal units.

2.4 COILS

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends are to be enclosed in terminal box. Fin surface temperature is not to exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless steel or corrosion-resistant material.

2.5 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated. Comply with requirements in Section 230500 "Common Work Results for HVAC."

2.6 CONTROLS

A. Control Devices:

1. Unit-mounted thermostat.

2.7 CAPACITIES AND CHARACTERISTICS

A. Refer to drawings for this information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PROPELLER UNIT HEATERS

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from masonry wall using manufacturer’s wall support bracket and manufacturer’s recommended masonry anchors.

3.3 CONNECTIONS

A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust initial temperature set points.

END OF SECTION 238239.16

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements generally applicable to all electrical Work on the Project, including but not limited to Work specified in Divisions 26, 27, and 28.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. A: Ampere, unit of electrical current.
2. AC or ac: Alternating current.
3. AIC: Ampere interrupting capacity.
4. AWG: American wire gauge; see ASTM B258.
5. BIL: Basic impulse insulation level.
6. BIM: Building information modeling.
7. BMS: Building management system.
8. CAD: Computer-aided design or drafting.
9. CB: Circuit breaker.
10. CU or Cu: Copper.
11. DC or dc: Direct current.
12. EGC: Equipment grounding conductor.
13. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
14. ft: Foot.
15. GEC: Grounding electrode conductor.
16. GFCI: Ground-fault circuit interrupter.
17. GFPE: Ground-fault protection of equipment.
18. GND: Ground.
19. HP or hp: Horsepower.
20. HVAC: Heating, ventilating, and air conditioning.
21. Hz: Hertz.
22. IBT: Intersystem bonding termination.
23. ICT: Information and communications technology.
24. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
25. I/O: Input/output.
26. IP: Ingress protection rating (enclosures); Internet protocol (communications).
27. IR: Infrared.
28. IS: Intrinsically safe.
29. kAIC: Kiloampere interrupting capacity.
30. kcmil: One thousand circular mils.

31. kV: Kilovolt.
32. kVA: Kilovolt-ampere.
33. kvar: Kilovolt-ampere reactive.
34. kW: Kilowatt.
35. kWh: Kilowatt-hour.
36. LCD: Liquid-crystal display.
37. LED: Light-emitting diode.
38. lm: Lumen, the SI-derived unit of luminous flux.
39. LRC: Locked-rotor current.
40. LV: Low voltage.
41. MCC: Motor-control center.
42. MOV: Metal-oxide varistor.
43. MV: Medium voltage.
44. N.C.: Normally closed.
45. N.O.: Normally open.
46. OCPD: Overcurrent protective device.
47. PF or pf: Power factor.
48. PLC: Programmable logic controller.
49. PVC: Polyvinyl chloride.
50. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
51. RMS or rms: Root-mean-square.
52. RPM or rpm: Revolutions per minute.
53. SCADA: Supervisory control and data acquisition.
54. SCCR: Short-circuit current rating.
55. SPD: Surge protective device.
56. sq.: Square.
57. TVSS: Transient voltage surge suppressor.
58. UL: (standards) UL Standards & Engagement Inc.; (product categories) UL, LLC.
59. V: Volt, unit of electromotive force.
60. V(ac): Volt, alternating current.
61. V(dc): Volt, direct current.
62. VA: Volt-ampere, unit of complex electrical power.
63. VAR: Volt-ampere reactive, unit of reactive electrical power.
64. VFC: Variable-frequency controller.
65. VOM: Volt-ohm-multimeter.
66. W: Watt, unit of real electrical power.
67. Wh: Watt-hour, unit of electrical energy usage.
68. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. Refer to Section 260533.13 "Conduits for Electrical Systems", Paragraph 1.2.A. for additional information.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. MC: Metal-clad cable.
2. MV: Medium-voltage cable.
3. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
4. THHW: Thermoplastic, heat- and moisture-resistant cable.

5. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
6. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
2. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
3. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
4. Conduit: A structure containing one or more duct raceways.
5. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.
6. Duct Raceway: A single enclosed raceway for conductors or cable.
7. Electrical Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
8. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

    a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
    b. Concrete Box: A box intended for use in poured concrete.
    c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
    d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
    e. Cover Plate: A cover designed for protecting wiring devices installed in flush-mounted device boxes while permitting their safe operation; also called a faceplate or wallplate.
    f. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
    g. Device Box: A box with provisions for mounting a wiring device directly to the box.
    h. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.

i. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
j. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
k. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
l. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
m. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
n. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

9. Jacket: A continuous nonmetallic outer covering for conductors or cables.
10. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
11. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein. Also called "single-line diagram."
12. Protective Device: A device that senses when an abnormal current flow, abnormal voltage potential, or other abnormal electrical waveform exists and then disconnects the affected portion of the circuit from the system. Common protective devices include fuses, circuit breakers, relays, ground-fault circuit interrupters, and arc-fault circuit interrupters.
13. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
14. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
15. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
c. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
d. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about

1 kV but not exceeding 69 kV.

16. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.
3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
   a. Emergency lighting.

1.4 PREINSTALLATION MEETINGS

A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after Notice to Proceed. Agenda topics include, but are not limited to, the following:

1. Electrical installation schedule.
2. Status of power system studies.
3. Value analysis proposals and requests for substitution of electrical equipment.
4. Site electrical work coordination and class of service requests.
5. Commissioning activities.
6. Sustainability activities, including Measurement and Verification Plan.

1.5 SEQUENCING

A. Conduct and submit results of power system studies before submitting product data and Shop Drawings for electrical equipment.

1.6 SCHEDULING

A. Refer to drawings for proposed sequence of demolition and new construction activities.

1.7 ACTION SUBMITTALS

A. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Coordination Drawings for Large Equipment Indoor Installations:

1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:

    a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
    b. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.

C. Coordination Drawings for Duct Banks:

1. Show duct profiles and coordination with other utilities and underground structures.
2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.8 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

1. Submission of power system studies.
2. Submission of specified coordination drawings.
3. Submission of action submittals specified in Division 26.
4. Orders placed for major electrical equipment.
5. Arrival of major electrical equipment on-site.
6. Preinstallation meetings specified in Division 26.
7. Electrical service outages.
8. Electrical service inspection and activation.
9. Mockup reviews.
10. Closing of walls and ceilings containing electrical Work.
11. System startup, testing, and commissioning activities for major electrical equipment.
12. System startup, testing, and commissioning activities for emergency lighting.
13. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
14. Requests for special inspections.
15. Requests for inspections by authorities having jurisdiction.

B. Qualification Statements:

1. For electrical professional engineer.
2. For ERMC-S-PVC raceway Installer.
3. For medium-voltage cable Installer.
4. For medium-voltage duct Installer.
5. For medium-voltage equipment Installer.
6. For medium-voltage and low-voltage electrical testing agency and on-site electrical testing supervisor.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:

    a. medium-voltage, metal-enclosed switchgear.

2. Include the following information:

    a. Manufacturer's operating specifications.
    b. User's guides for software and hardware.
    c. Schedule of maintenance material items recommended to be stored at the Project site.
    d. Detailed instructions covering operation under both normal and abnormal conditions.
    e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
    f. List of load-current and overload-relay heaters with related motor nameplate data.
    g. List of lamp types used on the Project, with ANSI and manufacturers' codes.
    h. Manufacturer's instructions for setting field-adjustable components.
    i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
    j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.

B. Software and Firmware Operational Documentation: Provide software and firmware operational documentation, including the following:

1. Software operating and upgrade manuals.
2. Names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency power features.
6. For lighting controls, include the following:

    a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
    b. Operation of adjustable zone controls.

C. Software:

1. Program Software Backup: Provide username and password for approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with the Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of electrical Work on the Project. Consult Architect for resolution of conflicting requirements.

END OF SECTION 260010

SECTION 260513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cables.
2. Connectors.
3. Solid terminations.
4. Separable insulated connectors.
5. Medium-voltage tapes.
6. Arc-proofing materials.
7. Fault indicators.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate location of each cable, splice, and termination.

B. Material Certificates: For each type of cable and accessory.

C. Design Data: Cable pulling calculations, including conduit size and fill percentage, pulling tensions, cable sidewall pressure, jam probability, voltage drop, and ground wire sizing for each cable.

D. Source quality-control reports.

E. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2 and NFPA 70.

C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. General Cable; Prysmian Group North America
2. Kerite Power Cable; Marmon Holdings, Inc.; Berkshire Hathaway Inc.
3. Okonite Company (The)
4. Southwire Company, LLC

B. Cable Type: Type MV 105.

C. Conductor Insulation: Ethylene-propylene rubber.

1. Voltage Rating: 5 kV.
2. Insulation Thickness: 133 percent insulation level.

D. Conductor: Copper.

E. Comply with UL 1072, AEIC CS8.

F. Shielding: Copper tape, helically applied over semiconducting insulation shield.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M
2. ABB, Electrification Business
3. Eaton

B. Copper-Conductor Connectors: Copper barrel crimped connectors.

2.4 SOLID TERMINATIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M
2. ABB, Electrification Business

B. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations:
    a. Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type connector.
    b. Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
    c. Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
    d. Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.

2. Class 2 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape; cold-shrink-rubber sleeve; or heat-shrink, plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
3. Class 3 Terminations: Kit with stress cone and compression-type connector.

2.5 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABB, Electrification Business
2. Eaton

C. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

D. Load-Break Cable Terminators: Elbow-type units with 200 A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is

capacitance coupled.

E. Dead-Break Cable Terminators: Elbow-type unit with 600 A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

F. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

G. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

H. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.6 MEDIUM-VOLTAGE TAPES

A. Description: Electrical grade, insulating tape rated for medium voltage application.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M
2. HellermannTyton
3.

C. Ethylene/propylene rubber-based, 30 mil splicing tape, rated for 130 deg C operation. Minimum 3/4 inch wide.

D. Silicone rubber-based, 12 mil self-fusing tape, rated for 130 deg C operation. Minimum 1-1/2 inch wide.

E. Insulating-putty, 125 mil elastic filler tape. Minimum 1-1/2 inch wide.

2.7 FAULT INDICATORS

A. Indicators: Automatically reset fault indicator, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.

2.8 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inch on the pull rope.

1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. Install direct-buried cables on leveled and tamped bed of 3 inch thick, clean sand. Separate cables crossing other cables or piping by a minimum of 2 inch of tamped earth, plus an additional 2 inch of sand. Install permanent markers at ends of cable runs, changes in direction, and buried splices.

G. Install "buried-cable" warning tape 12 inch above cables.

H. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

I. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

J. Install cable splices at pull points and elsewhere as indicated; use standard kits.

K. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.

L. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
3. Standoff Insulator: At each terminal junction, with one on each terminal.

M. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

N. Ground shields of shielded cable at one point only. Maintain shield continuity and connections to metal connection hardware at all connection points.

O. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
3. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.
4. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
5. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.

B. Medium-voltage cables will be considered defective if they do not pass tests and

inspections.

C. Prepare test and inspection reports.

END OF SECTION 260513

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpha Wire; brand of Belden, Inc.
2. Belden Inc.
3. Cerro Wire LLC
4. Encore Wire Corporation
5. General Cable; Prysmian Group North America
6. Okonite Company (The)
7. Service Wire Co.
8. Southwire Company, LLC
9. WESCO

B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems; Atkore International
2. Alpha Wire; brand of Belden, Inc.
3. Belden Inc.
4. Cerro Wire LLC
5. Encore Wire Corporation
6. General Cable; Prysmian Group North America
7. Okonite Company (The)
8. Southwire Company, LLC
9. WESCO

B. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.

D. Circuits:

1. Single circuit.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Bare.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2. Comply with UL 83.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M Electrical Products
2. ABB, Electrification Business
3. AFC Cable Systems; Atkore International
4. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
5. Gardner Bender
6. Hubbell Utility Solutions; Hubbell Incorporated
7. Ideal Industries, Inc.
8. ILSCO
9. NSi Industries LLC
10. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
11. Service Wire Co.
12. TE Connectivity Ltd.

B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper:
    a. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each of the following visual tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Inspect compression-applied connectors for correct cable match and indentation.
    c. Inspect for correct identification.
    d. Inspect cable jacket and condition.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Grounding (earthing) electrodes.
7. Grounding electrode enclosures.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
2. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

    a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
    b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
    c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are unacceptable for submitted product.

B. Shop Drawings: Prepare and submit the following:

1. Plans showing dimensioned locations of grounding features described in "Field Quality Control for Grounding and Bonding" Article, including the following:

    a. Grounding electrode access enclosures.
    b. Grounding electrodes.
    c. Grounding arrangements and connections for separately derived systems.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer's published instructions.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:
   a. Plans showing locations of grounding features described in "Field Quality Control for Grounding and Bonding" Article, including the following:
      1) Grounding electrode access enclosures.
      2) Grounding electrodes.
      3) Grounding arrangements and connections for separately derived systems.
   b. Instructions for periodic testing and inspection of grounding features at [test wells based on [NETA MTS.
      1) Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective action if values do not.
      2) Include recommended testing intervals.

1.5 QUALIFICATIONS

A. Electrical Power Testing (EPT) Technician III: Possessing active NICET EPT Level III certification. Able to manage switching procedures, conduct tests of complex equipment, analyze test and equipment data, plan a job, and lead a team. Has experience performing NFPA 70B, IEEE, and NETA electrical tests.

B. Electrical Power Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
   1. On-site electrical testing supervisors must possess active NICET EPT Technician [III certification.

1.6 SERVICE CONDITIONS FOR ELECTRICAL EQUIPMENT

A. Soil Resistivity: Grounding (earthing) Work on the Project must account for soil resistivity conditions.

B. Electrical and ICT Equipment Grounding (Earthing): Do not exceed 25 Ω resistance to

ground (earth).

1. Contact Architect for resolution if 25 Ω specified resistance to ground (earth) is not attained after complying with prescriptive requirements in Article 250 of NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. Standard Features: 600 V, THHN/THWN-2 or THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Bare Copper Grounding and Bonding Conductor:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ERICO; brand of nVent Electrical plc]
    b. Harger Lightning & Grounding; business of Harger, Inc.]

2. Standard Features: Complying with one or more of the following:

    a. Soft or Annealed Copper Wire: ASTM B3.
    b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
    c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
    d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.3 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.

B. Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ERICO; brand of nVent Electrical plc
    b. Harger Lightning & Grounding; business of Harger, Inc.

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing

laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Grounding and Bonding Equipment: UL 467.

4. Standard Features:

a. Two pieces with zinc-plated bolts.
b. Clamp Material:Copper.
c. Listed for outdoor use.

C. U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. ERICO; brand of nVent Electrical plc
c. [Harger Lightning & Grounding; business of Harger, Inc.

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Grounding and Bonding Equipment: UL 467.

4. Standard Features:

a. Clamp Material: Copper.
b. Listed for outdoor use.

D. Strap-Type Pipe and Rod Grounding and Bonding Clamp:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ERICO; brand of nVent Electrical plc

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Grounding and Bonding Equipment: UL 467.

4. Standard Features:

a. Clamp Material: Copper.
b. Listed for outdoor use.

E. Beam Grounding and Bonding Clamp:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. Panduit Corp

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

F. Exothermically Welded Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. ERICO; brand of nVent Electrical plc
c. Harger Lightning & Grounding; business of Harger, Inc.

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Bonding Bushing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. Crouse-Hinds; brand of Eaton, Electrical Sector

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Threaded bushing with insulated throat.

C. Grounding Bushing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.5 GROUNDING AND BONDING HUBS

A. Grounding and Bonding Hub:

1. Manufacturers: Subject to compliance with requirementsavailable manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business
   b. Crouse-Hinds; brand of Eaton, Electrical Sector

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.6 GROUNDING AND BONDING CONNECTORS

A. Pressure-Type Grounding and Bonding Busbar Cable Connector:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business
   b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Copper or copper alloy, for compression bonding of one or

more conductor directly to copper busbar. Listed for direct burial.

B. Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Mechanical-type, copper rated for direct burial terminal with set screw.

C. Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:

1. Manufacturers: Subject to compliance with requirementsavailable manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business
   b. Harger Lightning & Grounding; business of Harger, Inc.

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch centers for two-bolt connection to busbar.

D. Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Panduit Corp

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

E. Crimped Pressure-Type Grounding and Bonding Cable Connector:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business
   b. [Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.

   a. Copper, C and H shaped.

F. Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business
   b. ERICO; brand of nVent Electrical plc

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

   a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Bolts that surround cable and bond to cable under compression when nut is tightened.

   a. Copper.

2.7 GROUNDING (EARTHING) ELECTRODES

A. Rod Electrode:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABB, Electrification Business
   b. ERICO; brand of nVent Electrical plc
   c. Harger Lightning & Grounding; business of Harger, Inc.

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Grounding and Bonding Equipment: UL 467.

4. Standard Features: Copper-clad; 3/4 inch by 10 ft.

2.8 GROUNDING ELECTRODE ENCLOSURES

A. Description: Enclosures designed to protect grounding electrodes from damage while providing access for inspection and testing of the grounding system.

B. Grounding Electrode Access Well Enclosure :

1. Manufacturers: Subject to compliance with requirementsavailable manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ERICO; brand of nVent Electrical plc
b. Harger Lightning & Grounding; business of Harger, Inc.

2. Source Limitations: Obtain products from single manufacturer.
3. Standard Features:

a. Well Material: Concrete.
b. Cover Material: Cast iron.
c. Cover Strength: Sidewalk or turf use.

4. Other Available Features Required by the Project:

a. Round:

1) Nominal Diameter: 12 inch minimum.
2) Nominal Height: 18 inch minimum.
3) Slotted sides for installation after grounding connections made.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

A. Grounding and Bonding Conductors:

1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
7. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum.

B. Grounding and Bonding Connectors:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.3 INSTALLATION OF GROUNDING AND BONDING

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Maintenance: NFPA 70B.
3. Electrical Safety: NFPA 70E.
4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
5. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Grounding and Bonding Conductors:

a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
b. Underground Grounding Conductors:

1) Bury at least 30 inch below grade.

2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

g. Grounding and Bonding for Piping:

1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3. Electrodes:

a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2) Use exothermic welds for below-grade connections.

4. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground busbar. Install main bonding jumper between neutral and ground buses.

5. Grounding Underground Distribution System Components:

a. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
b. Comply with IEEE C2 grounding requirements.
c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.
d. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
e. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inch from foundation.

6. Equipment Grounding and Bonding:

a. Install insulated equipment grounding conductors with feeders and branch circuits.
b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1) Feeders and branch circuits.
2) Lighting circuits.
3) Receptacle circuits.
4) Single-phase motor and appliance branch circuits.
5) Three-phase motor and appliance branch circuits.
6) Flexible raceway runs.
7) Armored and metal-clad cable runs.

3.4 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-

resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:
   a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: (applicable to the 480-volt, 3-phase electrical power distribution) 10 Ω.
   b. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: (applicable to the 4,160-volt, 3-phase electrical power distribution) 3 Ω.

3.5 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support systems.
2. Mounting, anchoring, and attachment components.
3. Installation of fabricated metal supports.
4. Installation of concrete bases.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Prepare design calculations in accordance with criteria specified in Section 260010 "Supplemental Requirements for Electrical".

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT SYSTEMS

A. Steel Slotted Support Systems:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. Allied Tube & Conduit; Atkore International
c. Atkore Unistrut
d. CADDY; brand of nVent Electrical plc
e. Cooper B-line; brand of Eaton, Electrical Sector
f. Flex-Strut Inc.
g. G-Strut
h. Gripple Inc.
i. Haydon Corporation
j. Metal Ties Innovation
k. MIRO Industries Inc.
l. Rocket Rack; Robroy Industries
m. Wesanco/ZSi-Foster; an Ideal Tridon Group Company

2. Standard Features: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.

a. Referenced Standard: MFMA-4 factory-fabricated components for field assembly.
b. Material for Channel, Fittings, and Accessories: Galvanized steel.
c. Channel Width: Selected for applicable load criteria.
d. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
e. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
f. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices:

1. Standard Features: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit:

1. Standard Features: Factory-fabricated assembly consisting of threaded body and

insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints:

1. Standard Features: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

2.3 MOUNTING, ANCHORING, AND ATTACHMENT COMPONENTS

A. Powder-Actuated Fasteners :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hilti, Inc.
b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
c. MKT Fastening, LLC

B. Mechanical-Expansion Anchors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper B-line; brand of Eaton, Electrical Sector
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
e. MKT Fastening, LLC

2. Standard Features: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

C. Concrete Inserts:

1. Standard Features: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

D. Clamps for Attachment to Steel Structural Elements:

1. Standard Features: MSS SP-58 units are suitable for attached structural element.

E. Through Bolts:

1. Standard Features: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.

F. Toggle Bolts:

1. Standard Features: All steel springhead type.

G. Hanger Rods:

1. Standard Features: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION OF HANGERS AND SUPPORTS

A. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.

B. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Installation of Steel Conduit: NECA NEIS 101.
3. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Raceway Support Methods: In addition to methods described in NECA NEIS 1, ERMC may be supported by openings through structure members, in accordance with NFPA 70.
2. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
3. Mounting and Anchorage of Surface-Mounted Equipment and Components:

Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

a. To Wood: Fasten with lag screws or through bolts.
b. To New Concrete: Bolt to concrete inserts.
c. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
d. To Existing Concrete: Expansion anchor fasteners.
e. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
f. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
g. To Light Steel: Sheet metal screws.
h. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

4. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

D. Interfaces with Other Work:

1. Touchup Finishes:

a. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1) Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

b. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
c. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

2. Installation of Fabricated Metal Supports:

a. Provide site-fabricated metal supports.
b. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
c. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3. Installation of Concrete Bases:

a. Provide concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

b. Use 3000 psi, 28-day compressive-strength concrete.
c. Anchor equipment to concrete base as follows:

1) Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2) Install anchor bolts to elevations required for proper attachment to supported equipment.
3) Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type ERMC duct raceways, elbows, couplings, and nipples.
2. Type LFMC duct raceways.
3. Type PVC duct raceways and fittings.
4. Fittings for conduit, tubing, and cable.
5. Joint compounds.
6. Solvent cements.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
2. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).
3. Section 260529 "Hangers and Supports for Electrical Systems" specifies conduit hangers and supports referenced by this Section.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Raceway Types:

1. ERMC: Electrical rigid metal conduit.
2. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
3. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
4. LFMC: Liquidtight flexible metal conduit.
5. PVC-40: Schedule 40 rigid PVC conduit.

B. Definitions:

1. Conduit: A structure containing one or more duct raceways.
2. Direct Buried: Installed underground without encasement in concrete or other protective material.
3. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.
4. Duct Raceway: A single enclosed raceway for conductors or cable.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's published instructions.

1.5 QUALIFICATIONS

A. ERMC-S-PVC Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by ERMC-S-PVC manufacturer prior to starting installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE ERMC DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit; Atkore International
b. Crouse-Hinds; brand of Eaton, Electrical Sector
c. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
d. Republic Conduit; Nucor Corporation, Nucor Tubular Products

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. UL 6.

3. Standard Features:

a. Exterior Coating: Zinc.
b. Interior Coating: Zinc with organic top coating.
c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

B. PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business

b. Bluesteel Services LLC
c. Calbond; Atkore International
d. KorKap; Robroy Industries
e. Perma-Cote; Robroy Industries
f. Plasti-Bond; Robroy Industries

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. UL 6.

3. Standard Features:

a. Exterior Coating: PVC complying with NEMA RN 1.
b. Interior Coating: Zinc with organic top coating.
c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE LFMC DUCT RACEWAYS

A. Steel Liquid tight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. Anaconda Sealtite; Anamet Electrical, Inc
c. Electri-Flex Company
d. International Metal Hose Co

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. UL 360.

3. Standard Features:

a. Material: Steel.
b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. Calconduit; Atkore International
c. JM Eagle

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing

laboratory in accordance with guide information and standards specified for the following UL product categories:

a. UL 651.

2.5 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Fittings for Type ERMC, and Type PVC, Duct Raceways:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. Appleton; Emerson Electric Co., Automation Solutions
c. Crouse-Hinds; brand of Eaton, Electrical Sector
d. Konkore Fittings; Atkore International
e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
f. Southwire Company, LLC

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. UL 514B.

3. Standard Features:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

B. Fittings for Type LFMC Duct Raceways:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Arlington Industries, Inc.
b. Liquid Tight Connector Co.

2.6 JOINT COMPOUNDS

A. Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business

2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the

following UL product categories:

a. UL Subject 2419.

2.7 SOLVENT CEMENTS

A. Solvent Cements for Nonmetallic Duct Raceways and Fittings:

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

a. Solvent Cements: UL 340.
b. Solvent Cement Compatibility with PVC Conduit Fittings: UL 514B. Follow solvent manufacturer's published instructions.
c. Solvent Cement Compatibility with Rigid PVC Conduit: UL 651. Follow solvent manufacturer's published instructions.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in the Contract Documents or manufacturer's published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Subject to Severe Physical Damage: ERMC.
2. Exposed and Subject to Physical Damage: ERMC.
3. Exposed and Not Subject to Physical Damage: ERMC.
4. Concrete Encased in Trench: PVC-40.

C. Indoors:

1. .
2. Exposed and Subject to Physical Damage: ERMC.
3. Damp or Wet Locations: ERMC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Safety: NFPA 70E.
3. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
4. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
5. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
6. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
7. Expansion Fittings: NEMA FB 2.40.
8. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

a. Complete duct raceway installation before starting conductor installation.
b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
c. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
f. Support conduit within 12 inch of enclosures to which attached.
g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:

1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2) Where an underground service duct raceway enters a building or structure.
3) Conduit extending from interior to exterior of building.
4) Conduit extending into pressurized duct raceway and equipment.
5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6) Where otherwise required by NFPA 70.

i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
j. Do not install conduits within 2 inch of the bottom side of a metal deck roof.

k. Keep duct raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
m. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.

1) Termination fittings with shoulders do not require two locknuts.

o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

2. Types ERMC and IMC:

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.

3. Type ERMC-S-PVC:

a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC duct raceway.
c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.

4. Types LFMC:

a. Provide a maximum of 36 inch of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

5. Types PVC:

a. Do not install Type PVC conduit where ambient temperature exceeds

122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.

b. Comply with manufacturer's published instructions for solvent welding and fittings.

c. Join joints with solvent cement in accordance with manufacturer's published instructions and allowed to cure before handling. Joints to be bent, pushed, or pulled must set for minimum 24 h after joining.

6. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:

a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG.

7. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

a. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

b. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

8. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.

a. Provide warning signs.

D. Interfaces with Other Work:

1. Firestop penetrations of fire-rated floor and wall assemblies.
2. Provide conduit hangers and supports.

3.3 FIELD QUALITY CONTROL OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
3. Conduit Placement:

a. Verify that center-line location and offsets are in accordance with the Drawings.

b. Verify that hangers and supports for conduits are attached to structure as directed by qualified structural engineer.

c. Verify that nuts on bolts or hanger rods are secure.

d. Verify that space between raceways and cored holes are filled with non-shrinking grout or other approved material indicated on the Drawings and the Specifications.

e. Verify that expansion devices are installed at locations indicated on the

Drawings and the Specifications.

f. Verify that ends are cut square to provide flush-butting surfaces when spliced and inside edges are free of burrs that could impede installation of cables.

g. Verify minimum separation of utilities, or that approved mechanical protection has been provided to surrounding conduit(s) where minimum separation cannot be achieved.

4. Document all changes on Record Drawings.

B. Nonconforming Work:

1. Conduit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 CLEANING

A. Verify that bentonite or other drilling fluids are contained and removed, and site is restored to its original or improved condition.

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Sleeve-seal fittings.
3. Foam sealants.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, LLC
b. CCI Piping Systems
c. Flexicraft Industries
d. GPT; a division of EnPRO Industries
e. Specified Technologies Inc.

2. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

2.2 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to,

the following:

1. Holdrite; a division of Reliance Worldwide Corporation

B. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.3 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Innovative Chemical Products (Building Solutions Group
2. The Dow Chemical Company

B. Performance Criteria:

1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.
2. Sustainability Characteristics:
   a. Sealant must have a VOC content of 300 g/L or less.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit:

1. Interior Penetrations of Non-Fire-Rated Walls:
   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

B. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install conduits and cable with no crossings within the sleeve.

B. Fill opening around conduits and cables with expanding foam without leaving voids.

C. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Extruded insulating tubing.
3. Bands.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 LABELS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, polyester flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating, with protective shield over legend. Size labels such that clear shield overlaps entire printed legend.
2. Marker for Labels:
    a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
    a. 1-1/2 by 6 inch for raceway and conductors.
    b. 3-1/2 by 5 inch for equipment.
    c. As required by authorities having jurisdiction.

2.2 EXTRUDED INSULATING TUBING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL 224.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F.

2.3 BANDS

A. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

2.4 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.

C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.

D. Floor Marking Tape: 2 inch wide, 5 mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:

1. Tape:

    a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
    b. Printing on tape must be permanent and may not be damaged by burial operations.
    c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

    a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
    b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
    c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".

3. Detectable Line-Warning Tape :

    a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
    b. Width: 3 inch.
    c. Overall Thickness: 5 mil.
    d. Foil Core Thickness: 0.35 mil.
    e. Weight: 28 lb/1000 sq. ft.
    f. Tensile in accordance with ASTM D882: 70 lbf and 4600 psi.

4. Reinforced Detectable Line-Warning Tape :

    a. Reinforced, detectable three-layer laminate, consisting of printed pigmented woven scrim, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright-colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
    b. Width: 3 inch.
    c. Overall Thickness: 8 mil.
    d. Foil Core Thickness: 0.35 mil.
    e. Weight: 34 lb/1000 sq. ft.
    f. Tensile in accordance with ASTM D882: 300 lbf and 12,500 psi.

2.5 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Brady Corporation
b. Carlton Industries, LP
c. emedco
d. Grafoplast Wire Markers
e. LEM Products Inc.
f. Marking Services Inc.
g. Panduit Corp
h. Seton Identification Products; a Brady Corporation company

C. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Brady Corporation
b. Carlton Industries, LP
c. LEM Products Inc.
d. Pipemarker.com; Brimar Industries, Inc.
e. Seton Identification Products; a Brady Corporation company

2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:

a. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Brady Corporation
b. Carlton Industries, LP
c. Champion America
d. emedco
e. Marking Services Inc.

2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inch.

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

but are not limited to, the following:

a. Brady Corporation
b. Champion America
c. emedco
d. Marking Services Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inch.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Brady Corporation
b. Carlton Industries, LP
c. emedco
d. Marking Services Inc.
e. Seton Identification Products; a Brady Corporation company

2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
b. For signs larger than 20 sq. inch, 1/8 inch thick.
c. Engraved legend with black letters on white face.
d. Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. HellermannTyton
2. Ideal Industries, Inc.
3. Marking Services Inc.
4. Panduit Corp

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria: UL 1565 or UL 62275.

C. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

D. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

A. Pipe and Conduit Labeling: Comply with ASME A13.1.

B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color must be factory applied.
2. Colors for 208Y/120 V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.

3. Colors for 480Y/277 V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.

4. Color for Neutral (Grounded Conductor: White or gray.
5. Color for Equipment Ground: Green.

C. Color-Coding Raceways, Cable Trays, Junction Boxes, and Conductors for

Intrinsically-Safe Circuits: Light blue. When used to identify intrinsically-safe circuits, Article 504 of NFPA 70 requires that the color light blue not be used for any other purpose.

D. Color-Coding Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

E. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:

1. "POWER."

F. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

G. Locations of Underground Lines: Underground-line warning tape for power and lighting.

H. Vaults, Manholes, Handholes, and Pull and Junction Boxes, More Than 1000 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.

I. Concealed Raceways, Duct Banks, More Than 1000 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3 inch high, black letters on 20 inch centers.

1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10 ft maximum intervals.
2. Identify system voltage with black letters on orange field.
3. Apply floor marking tape to the following finished surfaces:

    a. Floor surface directly above conduits running beneath and within 12 inch of floor that is in contact with earth or is framed above unexcavated space.
    b. Wall surfaces directly external to raceways concealed within wall.
    c. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in building, or concealed above suspended ceilings.

J. Accessible Raceways, Armored and Metal-Clad Cables, More Than 1000 V: Vinyl wraparound labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
2. Identify system voltage with black letters on orange field.

K. Vaults, Manholes, Handholes, and Pull and Junction Boxes, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

2. Identify system voltage and system or service type with black letters on orange field.

L. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
2. Identify system voltage and system or service type with black letters on orange field.

M. Cover Plates: Label individual cover plates with self-adhesive labels. Place label at top of cover plate. Label cover plate with the following information, in the order listed:

1. Panelboard designation.
2. Colon or dash.
3. Branch circuit number.

N. Workspace Indication: Apply tape and stencil to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Equipment Identification Labels:

1. Black letters on white field.
2. Indoor Equipment: Baked-enamel signs.
3. Outdoor Equipment: Laminated acrylic or melamine sign.
4. Equipment to Be Labeled:
    a. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels.
    b. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
    c. Enclosures and electrical cabinets.
    d. Access doors and panels for concealed electrical items.
    e. Switchgear.
    f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
    g. Enclosed switches.
    h. Enclosed controllers.
    i. Monitoring and control equipment.

P. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 SELECTION OF SIGNS AND HAZARD MARKINGS

A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.

B. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Electrical Hazard Warnings:

1. Arc-Flash Hazard Warning: Self-adhesive labels. Comply with NFPA 70E and Section 260573 "Power System Studies" requirements for arc-flash hazard warning labels.
2. Raceways and Cables Carrying Circuits at More Than 1000 V:

a. Black letters on orange field.
b. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

3. Multiple Power Sources Warning Legend: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
4. OSHA Workspace Clearance Warning Legend: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

E. Operating Instruction Signs: Self-adhesive labels.

3.4 INSTALLATION

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes typical for electrical equipment environments specified in Section 260010 "Supplemental Requirements for Electrical."

C. Paint: Comply with requirements in painting Sections for paint materials and application

requirements. Retain paint system applicable for surface material and location (exterior or interior.

D. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

E. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

F. Install identifying devices before installing acoustical ceilings and similar concealment.

G. Verify identity of item before installing identification products.

H. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

I. Apply identification devices to surfaces that require finish after completing finish work.

J. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

M. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

N. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

O. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

Q. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

R. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns

of tape with no tension to prevent possible unwinding.

S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

T. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.

U. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape not less than 12 inch directly above cables or raceways buried 18 inch or more below grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

V. Nonmetallic Preprinted Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

W. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

X. Baked-Enamel Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

Y. Metal-Backed Butyrate Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

Z. Laminated Acrylic or Melamine Plastic Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

END OF SECTION 260553

SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Short-circuit study.
2. Overcurrent protective device coordination study.
3. Arc-flash hazard study.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Power System Study Reports:

1. Submit reports after approval of system protective devices submittals. Submittals must be in digital form.
2. Submit short-circuit study input data, including completed computer-program input data sheets.
3. Submit coordination study input data, including completed computer-program input data sheets.
4. Submit arc-flash study input data, including completed computer-program input data sheets.
5. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
6. Submit revised one-line diagram, reflecting field investigation results and results of short-circuit study.

B. Data files for studies in format compatible with Owner's power system analysis software.

1.3 QUALITY ASSURANCE

A. Submittals for power system studies must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.

C. Software algorithms must comply with requirements of standards and guides specified

in this Section.

D. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Standard Features:

1. Power System Analysis:
   a. Power-systems-analysis software applications must have analytical capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 3002 series standards.
   b. Computer software application must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.
   c. Computer software application must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.

2. Analysis Standards:
   a. Short-Circuit Current Analysis: In accordance with IEEE 3002.3.
   b. Device Coordination Analysis: In accordance with IEEE 3004.3 and IEEE 3004.5.
   c. Arc-Flash Hazard Analysis: In accordance with IEEE 1584.

3. Capable of printing arc-flash hazard warnings for equipment complying with NFPA 70E.
   a. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard study:
      1) Equipment designation.
      2) Nominal voltage.
      3) Protection boundaries.
         a) Arc-flash boundary.
         b) Restricted approach boundary.
         c) Limited approach boundary.
      4) Arc-flash PPE category.
      5) Required minimum arc rating of PPE in Cal/cm squared.
      6) Available incident energy.
      7) Working distance.

8) Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Collect and analyze data for power system studies.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers in accordance with NFPA 70E.
4. Gather and tabulate required input data to support power system studies. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 3002 series standards as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

    a. Product data for the Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
    b. Power sources and ties.
    c. Short-circuit current at each system bus (three phase and line to ground).
    d. Voltage level at each bus.
    e. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
    f. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
    g. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
    h. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
    i. Motor horsepower and NEMA MG 1 code letter designation.
    j. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
    k. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.2 PREPARATION

A. Preparation of Data for Short-Circuit Study:

1. Verify completeness of data supplied on one-line diagram. Call discrepancies to

Architect's attention.

2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
3. Prepare one-line diagram of modeled power system, showing the following:

    a. Protective device designations and ampere ratings.
    b. Conductor types, sizes, and lengths.
    c. Transformer kVA and voltage ratings.
    d. Motor and generator designations and kVA ratings.
    e. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
    f. Derating factors and environmental conditions.
    g. Revisions to electrical equipment required by study.

B. Preparation of Data for Overcurrent Protective Device Coordination Study:

1. Prepare data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, indicating the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
    k. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

2. Examine the Project's overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
3. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted

and approved prior to coordination study may not be used in study.

C. Preparation of Data for Arc-Flash Hazard Study:

1. Assemble data from short-circuit study and overcurrent protective device coordination study.
2. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.3 SHORT-CIRCUIT STUDY

A. Base study on device characteristics supplied by device manufacturer.

B. Extent of electrical power system to be studied is indicated on Drawings.

C. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.
2. Exclude equipment supplied by single transformer smaller than 75 kVA.

D. Study electrical distribution system from normal power sources throughout electrical distribution system for the Project.

E. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

F. Include in report identification of protective device applied outside its capacity.

3.4 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

A. Base study on device characteristics supplied by device manufacturer.

B. Extent of electrical power system to be studied is indicated on Drawings.

C. Begin analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.

D. Study electrical distribution system from normal power sources throughout electrical distribution system for the Project.

E. Transformer Primary Overcurrent Protective Devices:

1. Device must not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads in accordance with IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings must protect transformers in accordance with IEEE C57.12.00, for fault currents.

F. Motor Protection:

1. Select protection for low-voltage motors in accordance with IEEE 3004.8 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V in accordance with IEEE 620.

G. Conductor Protection: Protect cables against damage from fault currents in accordance with ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 3004.7. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

H. Include coordination of ground-fault protection devices.

I. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

J. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Application of series-rated devices must be recertified, complying with requirements in NFPA 70.
4. Include in report identification of protective device applied outside its capacity.

3.5 ARC-FLASH HAZARD STUDY

A. Comply with NFPA 70E, including Annex D, for arc-flash hazard study.

B. Preparatory Studies: Obtain short-circuit study and overcurrent protective device coordination study results prior to starting arc-flash hazard study.

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.

D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations.

F. Calculate limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must account for changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:

1. Fault contribution from induction motors must not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).

H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:

1. When circuit breaker is in separate enclosure.
2. When line terminals of circuit breaker are separate from work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.6 POWER SYSTEM STUDY REPORTS

A. Preparation of Power System Study Reports: Prepare and submit the following:

1. Short-Circuit Study Report Contents:

a. Executive summary of study findings.
b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
c. One-line diagram of modeled power system, showing the following:

1) Protective device designations and ampere ratings.
2) Conductor types, sizes, and lengths.
3) Transformer kVA and voltage ratings.
4) Motor designations and kVA ratings.
5) Switchgear, and panelboard designations and ratings.
6) Derating factors and environmental conditions.
7) Revisions to electrical equipment required by study.

d. Comments and recommendations for system improvements or revisions in

written document, separate from one-line diagram.

e. Short-Circuit Study Input Data:

1) One-line diagram of system being studied.
2) Power sources available.
3) Manufacturer, model, and interrupting rating of protective devices.
4) Conductors.
5) Transformer data.

f. Protective Device Evaluation:

1) Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2) Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3) For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4) For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5) Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

g. Short-Circuit Study Output Reports:

1) Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a) Voltage.
b) Calculated fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) Equivalent impedance.

2) Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a) Voltage.
b) Calculated symmetrical fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) Calculated asymmetrical fault currents based on fault-point X/R ratio; based on calculated symmetrical value multiplied by 1.6; and based on calculated symmetrical value multiplied by 2.7.

3) Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device

location:

a) Voltage.
b) Calculated symmetrical fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) No AC Decrement (NACD) ratio.
e) Equivalent impedance.
f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

2. Overcurrent Protection Device Coordination Study Report Contents:

a. Executive summary of study findings.
b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
c. One-line diagram of modeled power system, showing the following:

1) Protective device designations and ampere ratings.
2) Conductor types, sizes, and lengths.
3) Transformer kVA and voltage ratings.
4) Motor designations and kVA ratings.
5) Switchgear, and panelboard designations.
6) Revisions to electrical equipment required by study.

d. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.

1) Phase and Ground Relays:

a) Device tag.
b) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
c) Recommendations on improved relaying systems, if applicable.

2) Circuit Breakers:

a) Adjustable pickups and time delays (long time, short time, and ground).
b) Adjustable time-current characteristic.
c) Adjustable instantaneous pickup.
d) Recommendations on improved trip systems, if applicable.

3) Fuses: Show current rating, voltage, and class.

e. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for switching schemes and for emergency periods where power

source is local generation. Show the following information:

1) Device tag and title, one-line diagram with legend identifying portion of system covered.
2) Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
3) Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4) Plot the following listed characteristic curves, as applicable:

    a) Power utility's overcurrent protective device.
    b) Medium-voltage equipment overcurrent relays.
    c) Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    d) Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    e) Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    f) Cables and conductors damage curves.
    g) Ground-fault protective devices.
    h) Motor-starting characteristics and motor damage points.
    i) Largest feeder circuit breaker in each switchgear and panelboard.

5) Maintain selectivity for tripping currents caused by overloads.
6) Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7) Provide adequate time margins between device characteristics such that selective operation is achieved.
8) Comments and recommendations for system improvements.

3. Arc-Flash Hazard Study Report Contents:

    a. Executive summary of study findings.
    b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
    c. One-line diagram, showing the following:

        1) Protective device designations and ampere ratings.
        2) Conductor types, sizes, and lengths.
        3) Transformer kVA and voltage ratings, including derating factors and environmental conditions.
        4) Motor designations and kVA ratings.
        5) Switchgear, panelboard designations, and ratings.

    d. Short-circuit study output data.
    e. Overcurrent protective device coordination study report contents.
    f. Arc-Flash Study Output Reports:

        1) Interrupting Duty Report: Three-phase and unbalanced fault

calculations, showing the following for each equipment location included in report:

a) Voltage.
b) Calculated symmetrical fault-current magnitude and angle.
c) Fault-point X/R ratio.
d) No AC Decrement (NACD) ratio.
e) Equivalent impedance.
f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

g. Incident Energy and Flash Protection Boundary Calculations:

1) Arcing fault magnitude.
2) Protective device clearing time.
3) Duration of arc.
4) Arc-flash boundary.
5) Restricted approach boundary.
6) Limited approach boundary.
7) Working distance.
8) Incident energy.
9) Hazard risk category.
10) Recommendations for arc-flash energy reduction.

h. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

3.7 FIELD ADJUSTMENT FOR DEVICE COORDINATION

A. Adjust relay and protective device settings in accordance with recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting must be by qualified medium-voltage and low-voltage electrical testing and inspecting agency.

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

3.8 WARNING LABELING OF ARC-FLASH HAZARDS

A. Apply one arc-flash label on front cover of each section of equipment for each equipment included in study, including each piece of equipment listed below:

1. Medium-voltage switchgear.
2. Medium-voltage switches.
3. Panelboards.
4. Low voltage transformers.
5. Control panels.

B. Base arc-flash label data on highest values calculated at each location.

C. Machine print warning labels with no handwritten or field-applied markings.

D. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

E. Indicate on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

END OF SECTION 260573

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment connected to Normal electrical systems, including the following:

   a. Motor-control centers.
   b. Transformers.
   c. Secondary service electrical systems.
   d. Distribution and branch-circuit panelboards.
   e. Grounding systems.

2. Controls and instrumentation, including the following:

   a. Equipment monitoring systems.
   b. Electrical metering and metering system.

3. Systems testing and verification, including Normal electrical systems.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. BoD: Basis-of-Design Document, a document prepared by Architect that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

B. Cx: Commissioning, a quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements.

C. CxA: Commissioning Authority, an entity engaged to evaluate Commissioning-Process work.

D. OPR: Owner's Project Requirements, a document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies,

subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

A. Construction Checklists by CxA: Draft construction checklists will be created by CxA for Contractor review.

B. Construction Checklists by Contractor: Include the following for construction checklists:

1. Instrumentation and control for electrical systems.
2. Low-voltage power cables.
3. Control voltage power cables.
4. Electrical feeders and branch circuits.
5. Dry-type transformers.
6. Instrument transformers.
7. Low-voltage motor starters.
8. Low-voltage surge protective devices.
9. Medium-voltage power cables.
10. Medium-voltage circuit breakers.
11. Medium-voltage motor starters.
12. Medium-voltage surge arresters.
13. Protective relays.
14. Metering devices.
15. Molded-case circuit breakers.
16. Grounding systems.
17. Ground-fault protection systems.
18. Panelboards.
19. AC induction motors and generators.

1.4 QUALITY ASSURANCE

A. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:

    a. Equipment/instrument identification number.
    b. Planned Cx application or use.
    c. Manufacturer, make, model, and serial number.
    d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation must meet the following criteria:

    a. Capable of testing and measuring performance within the specified acceptance criteria.
    b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
    c. Be maintained in good repair and operating condition throughout duration

of use on Project.

d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

B. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

1) Instrument or tool identification number.
2) Equipment schedule designation of equipment for which the instrument or tool is required.
3) Manufacturer, make, model, and serial number.
4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.

c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLIST REVIEW

A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.

B. Return draft Construction Checklist review comments within 10 days of receipt.

C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date."

D. Use only construction checklists, marked "Approved for Use, (date."

3.2 GENERAL TESTING REQUIREMENTS

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that electrical instrumentation and control systems have been completed and

calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.

D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.

1. Contributors to development of construction checklists must include, but are not limited to, the following:

    a. Electrical systems and equipment installers.
    b. Electrical instrumentation and controls installers.

G. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.

K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.

L. Provide qualified testing and inspecting agency personnel in accordance with Section 260010 "Supplemental Requirements for Electrical," instrumentation, tools, and equipment to complete and document the following:

1. Performance tests.
2. Demonstration of a sample of performance tests.
3. Cx tests.
4. Cx test demonstrations.

3.3 Cx TESTS FOR ELECTRICAL SYSTEMS

A. Verification of Normal Electrical System Operation:

1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal electrical system.
2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
3. Test Purpose: Verify operation of Normal electrical system.
4. Test Conditions: Energize components of Normal electrical system, one at a time.
5. Acceptance Criteria: Proper operation of Normal electrical system over a 24-hour period.

B. Verification of Control and Instrumentation:

1. Prerequisites: Acceptance of results for construction checklists.

C. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential electrical systems.

D. Test Conditions:

1. Energize components of Normal electrical system.
2. Test operation of equipment.

E. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION 260800

SECTION 261323 - MEDIUM-VOLTAGE METAL-ENCLOSED SWITCHGEAR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Switchgear enclosure.
2. Fusible load interrupter switchgear.
3. Instruments.
4. Protective relays.
5. AC control power supply.
6. Warning labels and signs.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. ASYM: Asymmetrical.

B. SYM: Symmetrical.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
2. Time-current characteristic curves for overcurrent protective devices.

B. Shop Drawings: For medium-voltage, metal-enclosed switchgear.

1. Include a tabulation of installed devices with features and ratings.
2. Include dimensioned plans and elevations, showing dimensions, shipping sections, and weights of each assembled section. Elevations must show major components, features, and mimic bus diagram.
3. Include a plan view and cross section of equipment base showing clearances, manufacturer's recommended work space, and locations of penetrations for grounding and conduits. Show location of anchor bolts and leveling channels.
4. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, and location and size of each field connection.
5. Locate accessory and spare equipment storage.
6. Include single-line diagram.

7. Include control power wiring diagrams.
8. Include batteries, battery rack, equipment base, and room layout.
9. Include copy of nameplate.
10. Ratings of the assembled switchgear:

    a. Voltage.
    b. Continuous current.
    c. Short-circuit rating.
    d. BIL.

11. Design Calculations: Signed and sealed by a qualified structural professional engineer. Calculate requirements for selecting seismic restraints.
12. Wiring Diagrams: For each switchgear assembly include the following:

    a. Power, signal, and control wiring.
    b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
    c. Schematic control diagrams.
    d. Diagrams showing connections of component devices and equipment.
    e. Schematic diagrams showing connections to remote devices including SCADA remote terminal unit.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For switchgear and batteries, signed by product manufacturer.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Six of each type and rating of fuse and fusible device used, except for medium-voltage fuses and fuses associated with network protector. Include spares for the following:

    a. Primary disconnect fuses.
    b. Potential transformer fuses.
    c. Control power fuses.
    d. Fuses and fusible devices for fused circuit breakers.

2. Spare Indicating Lights: Six of each type installed.
3. Touchup Paint: Three half-pint containers of paint matching enclosure's exterior finish.
4. Primary Switch Contact Lubricant: One container(s).

1.6 WARRANTY

A. Special Battery Warranties: Manufacturer and Installer agree to repair or replace the switchgear control system storage batteries that fail in materials or workmanship within specified warranty period.

1. Warranted Cycle Life for VRLA Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F:

a. For discharge rate not faster than 8 hours, discharge duration not longer than 8 hours, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 6 discharge cycles.
b. For discharge rate not faster than 30 minutes, discharge duration not longer than 30 minutes, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 20 discharge cycles.
c. For discharge rate not faster than 15 minutes, discharge duration not longer than 45 seconds, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 120 discharge cycles.

2. Warranted Cycle Life for Premium VRLA Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F:

a. For discharge rate not faster than 8 hours, discharge duration not longer than 8 hours, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 40 discharge cycles.
b. For discharge rate not faster than 30 minutes, discharge duration not longer than 30 minutes, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 125 discharge cycles.
c. For discharge rate not faster than 15 minutes, discharge duration not longer than 90 seconds, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 750 discharge cycles.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Manufactured Unit: Metal-enclosed switchgear, designed for application in solidly grounded neutral system.

B. Switchgear Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory, and marked for intended location and application.

C. Comply with IEEE C37.20.3.

2.2 MEDIUM-VOLTAGE METAL-ENCLOSED SWITCHGEAR

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABB, Electrification Business
2. Siemens Industry, Inc., Energy Management Division
3. Square D; Schneider Electric USA

2.3 SWITCHGEAR ENCLOSURE

A. Indoor Enclosure: Steel.

B. Enclosure Finish:

1. Indoor Finish: Factory-applied finish in manufacturer's standard gray over a rust-inhibiting primer on treated metal surface.

2.4 FUSIBLE LOAD INTERRUPTER SWITCHGEAR

A. Construction:

1. Deadfront, metal-enclosed, fixed-mount, fusible interrupter switchgear assembly of vertical sections.

    a. Front and rear access switchgear.
    b. Viewing window to show view of the position of the three poles of the interrupter.
    c. Mechanical interlock preventing the door from opening when the switch is open and requiring the door to be closed before the switch can be closed.
    d. Padlocking and tagging the switch in the opened or closed position.
    e. Switch position indicator.
    f. Front and rear vertical section covers must have full-length hinges. The front cover must be a flanged door with latching hardware. The rear cover may be bolted.

2. Bus: Tin-plated copper.

    a. Ground Bus: Sized to carry the rated short-time withstand current and connected to the metal enclosures of each vertical section.
    b. Neutral Bus: Rated 1,200 A.

B. Switches: Load interrupter type, with fuses. Omit fuses where specifically indicated.

1. Switch Operator: Manual.
2. Switch Construction:

    a. Grounded, metal shield to cover live components and terminals.
    b. Supported entirely by interior framework of structure, with copper switchblades and stored-energy operating mechanism.
    c. Phase barriers, full length of switchblades and fuses for each pole; readily removable and replaceable; designed to allow visual inspection of switch components when barrier is in place.

3. Fuses:

    a. Installed on a single mounting frame, de-energized when the switch is open.
    b. Current-Limiting Fuses: Full-range, fast-replaceable, current-limiting type that will operate without explosive noise or expulsion of gas, vapor, or foreign matter from tube.
    c. Indicator integral with each fuse to show when it has blown.
    d. Spares: Include three fuses in use and three spare fuses in storage clips in each switch.

C. Accessory Set:

1. Tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation.
2. Fuse-handling tool recommended by switchgear manufacturer.

D. Capacities and Characteristics:

1. Switchgear Assembly:

    a. Rated Maximum Voltage and BIL: 4.76 kV, 60 kV.
    b. Rated Continuous Current: 1200 A.
    c. Rated Momentary Withstand Current (600 A and 1200 A Continuous Current Ratings): 40 kA ASYM RMS for 10 cycles.
    d. Rated Short-Time Withstand Current (600 A and 1200 A Continuous Current Ratings): 25 kA SYM RMS for 2 s.
    e. Rated Momentary Withstand Current (2000 A Continuous Current Rating): 61 kA ASYM RMS for 10 cycles.
    f. Rated Short-Time Withstand Current (2000 A Continuous Current Rating): 38 kA SYM RMS for 2 s.

2. Fused Switches with Current Limiting Fuses:

    a. Fuse Type and Rated Continuous Current.
    b. Fuse Interrupting Rating: 50 kA SYM RMS minimum.

E. Medium Voltage Starters

1. The medium voltage starter shall be designed to accommodate motor of the size and type as shown on the drawings and part of the fusible load interrupter switchgear sections of the complete medium voltage, metal-enclosed switchgear lineup. The medium voltage starters shall be UL listed and solid-state reduced voltage reversing type to accommodate an induction motor that includes the following equipment and devices:

    a. Medium Voltage Compartment: At minimum, this section shall be complete with isolating switch composed of fixed portion with shutter mechanism and removable portion with blown fuse indication, bolt-in current limiting power fuses, one (1) three-pole main vacuum contactor assembly, one (1) stab-in bypass vacuum contactor assembly, one (1) roll-out three-phase, solid-state device assembly, control circuit transformer including primary and secondary

control circuit transformer fusing, electrical interlocks, current transformers suitable for use with motor protection relay and electronic meter and current transformer for zero sequence ground fault where ground fault protection is required.

b. Low Voltage Compartment: At minimum, this section shall be complete with motor protection relay, interposing control relay, control circuit terminal blocks, potential transformer(s), and current transformer shorting terminal block.

F. Motor Protective Relays

1. Microprocessor-based, multifunction overcurrent relay with the minimum following device functions:

a. 50, 51, 500G, 51G, 27, 59, and 86.

G. Surge Arresters: Comply with IEEE C62.11, distribution class; metal-oxide-varistor type, connected in each phase of incoming circuit and ahead of disconnecting device.

2.5 INSTRUMENTS

A. Instrument Transformers: Comply with IEEE C57.13.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA C 12.11 accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

2.6 PROTECTIVE RELAYS

A. Multifunctional, solid-state microprocessor-based relay systems complying with IEEE C37.90.

B. Relay Mounting:

1. Each relay must be mounted in a draw out case with a two-stage quick-release operation.
2. Removal of the relay from the case must disconnect the trip circuits and short the current-transformer secondaries before the unit control power is disconnected.
3. When the relay is inserted into the case, control power connections must be made before the trip circuits are activated.
4. Include a self-shorting contact on the case terminal block for alarm indication and tripping of circuit breaker upon removal of the relay from the case.

C. Equip each relay system with a communications module to transmit the following data:

1. Relay's metered and target data, such as currents, set points, cause of trip, magnitude of trip current, and open-close trip status.
2. Ability to close and open the associated breaker with proper access code from remote location over the communication network when the relay is configured in remote open-close mode.

D. Overcurrent and Ground-Fault Protective Relays:

1. IEEE C37.2 Device Functions: 51/50 and 51/50N.
2. Field-Selectable Relay Settings: Required by the overcurrent protective device coordination study and arc-flash study.
3. Primary Current-Transformer Ratings: Programmable from 5 to 5000 A.
4. Phase and Ground Protection: Field-selectable curves from IEEE moderately inverse, very inverse, or extremely inverse.
5. Phase Instantaneous Overcurrent Trip Pickup Point: Field selectable as "none" or from 1.0 to 25 times current-transformer primary rating. Include discriminator circuit with "on" and "off" switch so that when phase instantaneous overcurrent has been programmed to "none," the discriminator circuit protects against currents exceeding 11 times current-transformer primary rating when the breaker is being closed and must be deactivated after approximately eight cycles.
6. Contacts:

    a. Two Form-A contacts.
    b. Field selectable into contact pairs as follows and as required by the overcurrent protective device coordination study and arc-flash study:

        1) One contact assigned ANSI 51 phase and ANSI 51 ground, and the other contact assigned ANSI 50 phase and ANSI 50 ground.
        2) One contact assigned ANSI 51/50 phase, and the other contact assigned 51/50 ground.

7. Alphameric display to show the following parameters with metering accuracy not to exceed 2 percent of full scale:

    a. Individual phase currents.
    b. Ground current.
    c. Cause of trip.
    d. Magnitude and phase of current-causing trip.
    e. Phase or ground indication.
    f. Peak current demand for each phase and ground since last reset.
    g. Current-transformer primary rating.
    h. Programmed phase and ground set points.

8. Relay alarm and trip contacts must not change state if power is lost or an undervoltage occurs. These contacts must only cause a trip on detection of an overcurrent or fault condition based on programmed settings. Provide a "protection off" alarm, which must be normally energized when the relay is powered and the self-diagnostics indicates the unit is functional. On loss of power or relay failure, this alarm relay must be de-energized, providing a fail-safe protection off alarm.

2.7 AC CONTROL POWER SUPPLY

A. Description:

1. Control power transformer must supply 120 V control circuits through secondary disconnect and overcurrent protective devices.

a. Dry-type transformer, in separate compartment, with primary and secondary fuses to provide current-limiting and overload protection.

2.8 CONTROL NETWORK

A. Compliance with ASHRAE 135: Controllers must support serial MS/TP and Ethernet IP communications and must be able to communicate directly via TIA-485 serial networks and Ethernet 10Base-T networks as a native device.

2.9 WARNING LABELS AND SIGNS

A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

1. Warning signs must be baked enamel signs.
2. Equipment Identification Labels: Laminated acrylic or melamine label.

2.10 SOURCE QUALITY CONTROL

A. Perform production tests on each circuit breaker housing for this Project, complying with IEEE C37.20.3:

1. Perform mechanical operation tests to ensure proper functioning of shutters, operating mechanism, mechanical interlocks, and interchangeability of removable elements that are designed to be interchangeable.
2. Verify that control wiring is correct by verifying continuity. Perform electrical operation of relays and devices to ensure they function properly and in the intended sequence.
3. Perform the control wiring dielectric test at 1500 V for one minute.

B. Perform production tests, on each circuit breaker supplied for this Project, complying with IEEE C37.20.4.

1. Perform mechanical operation tests to ensure proper functioning of the switch.
2. Verify the contact gap. Perform terminal-to-terminal resistance test.
3. Verify that control wiring is correct by verifying continuity. Perform electrical operation of relays and devices to ensure they function properly and in the intended sequence.
4. Perform the control wiring dielectric test at 1500 V for one minute.

C. Owner will witness required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Upon delivery of switchgear and prior to unloading, inspect equipment for damage.

1. Examine tie rods and chains to verify they are undamaged and tight and that blocking and bracing are tight.
2. Verify that there is no evidence of load shifting in transit and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
3. Examine switchgear for external damage, including dents or scratches in doors and sill, and termination provisions.
4. Compare switchgear and accessories received with the bill of materials to verify that the shipment is complete. Verify that switchgear and accessories conform to the manufacturer's quotation and shop drawings. If the shipment is not complete or does not comply with project requirements, notify the manufacturer in writing immediately.
5. Unload switchgear, observing packing label warnings and handling instructions.
6. Open compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

1. Handle switchgear in accordance with manufacturer's recommendations; avoid damage to the enclosure, termination compartments, base, frame, tank, and internal components. Do not subject switchgear to impact, jolting, jarring, or rough handling.
2. Protect switchgear compartments against the entrance of dust, rain, and snow.
3. Transport switchgear upright to avoid internal stresses on equipment mounting assemblies. Do not tilt or tip switchgear.
4. Use spreaders or a lifting beam to obtain a vertical lift and to protect switchgear from straps bearing against the enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
5. Do not damage structure when handling switchgear.

C. Storage:

1. Store switchgear in a location that is clean and protected from weather. Protect switchgear from dirt, water, contamination, and physical damage. Do not store switchgear in the presence of corrosive or explosive gases.
2. Store switchgear with compartment doors closed.
3. Regularly inspect switchgear while in storage and maintain documentation of storage conditions, noting any discrepancies or adverse conditions.

D. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will have to cross section barriers to reach load or line lugs.

E. Pre-Installation Checks:

1. Verify removal of any shipping bracing after placement.

F. Verify that ground connections are in place and that requirements in Section 260526

"Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 ohms at switchgear location.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SWITCHGEAR

A. Equipment Mounting:

1. Install switchgear on cast-in-place concrete equipment base(s).
2. Comply with requirements for vibration isolation devices specified in Section 260529 "Hangers and Supports for Electrical Systems."

B. Switchgear must be installed level and plumb. Switchgear must tilt less than 1.5 degrees while energized.

C. Maintain minimum clearances and workspace at equipment in accordance with manufacturer's written instructions and NFPA 70.

D. Comply with NECA 430.

3.3 CONNECTIONS

A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Grounding Connections at Interior Locations:

1. Install bare copper cable not smaller than No. 4/0 AWG for grounding to grounding electrodes.
2. Bond surge arrester and neutrals directly to the switchgear enclosure and then to the grounding electrode system with bare copper conductors.
3. Keep leads as short as practicable with no kinks or sharp bends.
4. Make joints in grounding conductors and loops by exothermic weld or compression connector.

C. Terminate all grounding and bonding conductors on a common equipment grounding terminal on the switchgear enclosure. Install supplemental terminal bars, lugs, and bonding jumpers as required to accommodate the number of conductors for termination.

D. Complete switchgear grounding and lightning arrester connections prior to making any other electrical connections.

E. Terminate medium-voltage cables in accordance with Section 260513 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

A. Comply with the installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

B. Install warning signs as required to comply with OSHA in 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

A. General Field Testing Requirements:

1. Comply with the provisions of NFPA 70B, "Testing and Test Methods."
2. After installing switchgear and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.

B. Medium-Voltage Switchgear Assembly Field Tests:

1. Visual and Mechanical Inspection:

a. Verify that fuse and circuit breaker sizes and types correspond to Drawings and coordination study, as well as to the circuit breaker's address in the control network.
b. Verify that current and voltage transformer ratios correspond to Drawings.
c. Inspect bolted electrical connections using calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
d. Confirm correct operation and sequencing of electrical and mechanical interlock systems.

1) Attempt closure on locked-open devices. Attempt to open locked-closed devices.
2) Make key exchange with devices operated in off-normal positions.

e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Inspect insulators for evidence of physical damage or contaminated surfaces.
g. Verify correct barrier and shutter installation and operation.
h. Exercise active components.
i. Inspect mechanical indicating devices for correct operation.
j. Verify that filters are in place and vents are clear.
k. Perform visual and mechanical inspection of instrument transformers in accordance with Article "Instrument Transformer Field Tests."
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads,

tightness of connections, defective wiring, and overall general condition.

2) Verify that primary and secondary fuse or circuit breaker ratings match drawings.

3) Verify correct functioning of drawout disconnecting and grounding contacts and interlocks.

2. Electrical Tests:

a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Perform dc voltage insulation-resistance tests on each bus section, phase to phase and phase to ground, for one minute. If the temperature of the bus is other than plus or minus 20 deg C, adjust the resulting resistance as provided in NETA ATS, Table 100.11.

1) Insulation-resistance values of bus insulation must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.1.

2) Do not proceed to the dielectric withstand voltage tests until insulation-resistance levels are raised above minimum values.

c. Perform a dielectric withstand voltage test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it must be conducted in accordance with NETA ATS, Table 100.2. Apply the test voltage for one minute.

1) If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

1) Minimum insulation-resistance values of control wiring must not be less than two megohms.

e. Control Power Transformers:

1) Perform insulation-resistance tests. Perform measurements from winding to winding and each winding to ground. Insulation-resistance values of winding insulation must be in accordance with manufacturer's published data. In the absence of manufacturer's

published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.1.

2) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source. Verify correct potential at all devices.
3) Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
4) Verify correct function of control transfer relays located in the switchgear with multiple control power sources.

f. Voltage Transformers:

1) Perform secondary wiring integrity test. Verify correct potential at all devices.
2) Verify secondary voltages by energizing the primary winding with system voltage.

g. Perform current-injection tests on the entire current circuit in each section of switchgear.

1) Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 A flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.
2) Perform current tests by primary injection with magnitudes such that a minimum of 1.0 A flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.

h. Perform system function tests in accordance with "System Function Tests" Article.
i. Verify operation of space heaters.
j. Perform phasing checks on double-ended or dual-source switchgear to ensure correct bus phasing from each source.

C. Medium-Voltage Vacuum Circuit Breaker Field Tests:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and required clearances.
c. Verify that maintenance devices such as special tools and gages specified by the manufacturer are available for servicing and operating the breaker.
d. Verify the unit is clean.
e. Perform mechanical operation tests on operating mechanism in accordance with manufacturer's published data.
f. Measure critical distances on operating mechanism as recommended by the manufacturer. Critical distances of the operating mechanism must be in accordance with manufacturer's published data.
g. Verify cell fit and element alignment.
h. Verify racking mechanism operation.

i. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
k. Record as-found and as-left operation counter reading. Operation counter must advance one digit per close-open cycle.

2. Electrical Tests:

a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Insulation-resistance values must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than this table or manufacturer's recommendations. Dielectric-withstand-voltage tests must not proceed until insulation-resistance levels are raised above minimum values.
b. Perform a contact/pole-resistance test. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value. Microhm or dc millivolt drop values must not exceed the high levels of the normal range in accordance with manufacturer's published data. If manufacturer's published data is not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform minimum pickup voltage tests on trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the trip and close coils must comply with manufacturer's published data. In the absence of the manufacturer's published data, comply with NETA ATS, Table 100.20.
d. Verify correct operation of any auxiliary features, such as electrical close and trip operation, trip-free operation, and anti-pump function. Auxiliary features must operate in accordance with manufacturer's published data.
e. Trip circuit breaker by operation of each protective device. Reset trip logs and indicators.
f. Perform power-factor or dissipation-factor tests on each pole with the breaker open and each phase with the breaker closed. Power-factor or dissipation-factor values must comply with manufacturer's published data.
g. Perform vacuum bottle integrity (dielectric-withstand-voltage) test across each vacuum bottle, with the contacts in the "open" position in accordance with manufacturer's published data. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the vacuum bottle integrity test, the test specimen is considered to have passed the test.
h. Perform a dielectric-withstand-voltage test in accordance with manufacturer's published data. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric-withstand-voltage test, the test specimen is considered to have passed the test.

i. Verify operation of heaters.

D. Instrument Transformer Field Tests:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data complies with Contract Documents.
b. Inspect physical and mechanical condition.
c. Verify correct connection of transformers with system requirements.
d. Verify that adequate clearances exist between primary and secondary circuit wiring.
e. Verify the unit is clean.
f. Inspect bolted electrical connections using calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
g. Verify that required grounding and shorting connections provide contact.
h. Verify correct operation of transformer withdrawal mechanism and grounding operation.
i. Verify correct primary and secondary fuse sizes for voltage transformers.
j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

2. Electrical Tests of Current Transformers:

a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Perform insulation-resistance test of each current transformer and its secondary wiring with respect to ground at 1000 V(dc) for one minute. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's written recommendations. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.5.
c. Perform a polarity test of each current transformer in accordance with IEEE C57.13.1. Polarity results must agree with transformer markings.
d. Perform an excitation test on transformers used for relaying applications in accordance with IEEE C57.13.1. Excitation results must match the curve supplied by the manufacturer or be in accordance with IEEE C57.13.1.
e. Measure current circuit burdens at transformer terminals in accordance with IEEE C57.13.1. Measured burdens must be compared with and must match instrument transformer ratings.
f. Perform insulation-resistance tests on the primary winding with the secondary grounded. Test voltages must be in accordance with Table 100.5.
g. Perform dielectric withstand tests on the primary winding with the secondary grounded. Test voltages must be in accordance with Table 100.9.

h. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data.
i. Verify that current transformer secondary circuits are grounded and have only one grounding point in accordance with IEEE C57.13.3. That grounding point should be located as specified by the engineer in the project drawings.

3. Electrical Tests of Voltage Transformers:

a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests winding-to-winding and each winding to ground. Test voltages must be applied for one minute in accordance with Table 100.5. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's recommendations. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.5.
c. Perform a polarity test on each transformer to verify the polarity marks or H1- X1 relationship as applicable. Polarity results must agree with transformer markings.
d. Measure voltage circuit burdens at transformer terminals. Measured burdens must be compared with and must match instrument transformer ratings.
e. Perform a dielectric withstand test on the primary windings with the secondary windings connected to ground. The dielectric voltage must be in accordance with Table 100.9. The test voltage must be applied for one minute. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary windings are considered to have passed the test.
f. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data. Power-factor or dissipation-factor values must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use test equipment manufacturer's published data.
g. Verify that voltage transformer secondary circuits are grounded and have only one grounding point in accordance with IEEE C57.13.3. Test results must indicate that the circuits are grounded at only one point.

E. Ground Resistance Test:

1. Visual and Mechanical Inspection:

a. Verify ground system complies with the Contract Documents and NFPA 70 Article 250, "Grounding and Bonding."
b. Inspect physical and mechanical condition. Grounding system electrical and mechanical connections must be free of corrosion.
c. Inspect bolted electrical connections using a calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's

published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

d. Inspect anchorage.

2. Electrical Tests:

a. Perform fall-of-potential or alternative test in accordance with IEEE 81 on the main grounding electrode or system. The resistance between the main grounding electrode and ground must be no more than 5 ohms.

b. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points. Investigate point-to-point resistance values that exceed 0.5 ohms. Compare equipment nameplate data with Contract Documents.

c. Inspect physical and mechanical condition.

d. Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

F. Metering Devices Field Tests:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.

b. Inspect bolted electrical connections using calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.

c. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case shorting contacts, as applicable.

d. Verify the unit is clean.

e. Verify freedom of movement, end play, and alignment of rotating disk(s).

2. Electrical Tests:

a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Verify accuracy of meters at all cardinal points. Meter accuracy must be in accordance with manufacturer's published data.

c. Calibrate meters in accordance with manufacturer's published data. Calibration results must be within manufacturer's published tolerances.

d. Verify all instrument multipliers. Instrument multipliers must be in accordance with system design specifications.

e. Verify that current transformer and voltage transformer secondary circuits are intact. Test results must confirm the integrity of the secondary circuits of current and voltage transformers.

G. Medium-Voltage Surge Arrester Field Tests:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data complies with Contract Documents.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify the arresters are clean.
e. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
f. Verify that the stroke counter is correctly mounted and electrically connected if applicable. Record the stroke counter reading.

2. Electrical Test:

a. Perform an insulation-resistance test on each arrester, phase terminal to ground. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to meet recommended minimum insulation resistance listed in the table.
b. Perform a watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.
c. Test grounding connections. Resistance between the arrester ground terminal and the ground system must be less than 0.5 ohm.

H. Microprocessor-Based Protective Relay Field Tests:

1. Visual and Mechanical Inspection:

a. Record model number, style number, serial number, firmware revision, software revision, and rated control voltage.
b. Verify operation of light-emitting diodes, display, and targets.
c. Record passwords for each access level.
d. Clean the front panel and remove foreign material from the case.
e. Check tightness of connections.
f. Verify that the frame is grounded in accordance with manufacturer's instructions.
g. Set the relay in accordance with results in Section 260573.16 "Coordination Studies" and in Section 260573.19 "Arc-Flash Hazard Analysis."
h. Download settings from the relay. Print a copy of the settings for the report and compare the settings to those specified in the coordination study.

2. Electrical Tests:

a. Perform insulation-resistance tests from each circuit to the grounded frame in accordance with manufacturer's published data.
b. Apply voltage or current to analog inputs, and verify correct registration of the relay meter functions.
c. Functional Operation: Check functional operation of each element used in the protection scheme as follows where applicable:

1) Timing Relay:

   a) Determine time delay.
   b) Verify operation of instantaneous contacts.

2) Volts/Hertz Relay:

   a) Determine pickup frequency at rated voltage.
   b) Determine pickup frequency at a second voltage level.
   c) Determine time delay.

3) Sync Check Relay:

   a) Determine closing zone at rated voltage.
   b) Determine maximum voltage differential that permits closing at zero degrees.
   c) Determine live line, live bus, dead line, and dead bus set points.
   d) Determine time delay.
   e) Verify dead bus/live line, dead line/live bus, and dead bus/dead line control functions.

4) Undervoltage Relay:

   a) Determine dropout voltage.
   b) Determine time delay.
   c) Determine time delay at a second point on the timing curve for inverse time relays.

5) Directional Power Relay:

   a) Determine minimum pickup at maximum torque angle.
   b) Determine closing zone.
   c) Determine maximum torque angle.
   d) Determine time delay.
   e) Verify time delay at a second point on the timing curve for inverse time relays.

6) Current Balance Relay:

   a) Determine pickup of each unit.
   b) Determine percent slope.
   c) Determine time delay.

7) Negative Sequence Current Relay:

   a) Determine negative sequence alarm level.
   b) Determine negative sequence minimum trip level.
   c) Determine maximum time delay.
   d) Verify two points on the I-two-squared-t curve.

8) Phase Sequence or Phase Balance Voltage Relay:

a) Determine positive sequence voltage to close the NO contact.
b) Determine positive sequence voltage to open the NC contact (undervoltage trip).
c) Verify negative sequence trip.
d) Determine time delay to close the NO contact with sudden application of 120 percent of pickup.
e) Determine time delay to close the NC contact upon removal of voltage when previously set to rated system voltage.

9) Instantaneous Overcurrent Relay:

a) Determine pickup.
b) Determine dropout.

10) Time Overcurrent:

a) Determine minimum pickup.
b) Determine time delay at two points on the time current curve.

11) Ground Detector Relay:

a) Determine maximum impedance to ground causing relay pickup.

12) Directional Overcurrent Relay:

a) Determine directional unit minimum pickup at maximum torque angle.
b) Determine closing zone.
c) Plot operating characteristics.
d) Determine overcurrent unit pickup.
e) Determine overcurrent unit time delay at two points on the time current curve.

d. Control Verification:

1) Functional Tests:

a) Check operation of all active digital inputs.
b) Check output contacts or silicone-controlled rectifiers (SCRs), preferably by operating the controlled device, such as circuit breaker, auxiliary relay, or alarm.
c) Check internal logic functions used in protection scheme.
d) Upon completion of testing, reset min/max recorders, communications statistics, fault counters, sequence-of-events recorder, and event records.

2) In-Service Monitoring: After the equipment is initially energized, measure magnitude and phase angle of inputs and verify expected values.

I. Nonconforming Work:

1. Switchgear will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

J. Prepare test and inspection reports. Record as-left set points of adjustable devices.

3.6 SYSTEM FUNCTION TESTS

A. System function tests must prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of sensing devices, alarms, and indicating devices.

3.7 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: After Substantial Completion, but not more than six months after Final Acceptance, if requested by Owner, perform the following voltage monitoring:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each switchgear. Use voltmeters with calibration traceable to NIST standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:

    a. Adjust switchgear taps.
    b. Prepare written request for voltage adjustment by electric utility.

3. Retests: Repeat monitoring, after corrective action has been performed, until specified results are obtained.
4. Report:

    a. Prepare a written report covering monitoring performed and corrective action taken.

B. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove covers prior to the inspection.

1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of the switchgear.
2. Instrument: Inspect distribution systems with imaging equipment capable of

detecting a minimum temperature difference of 1deg C at 86 deg F.

3. Record of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used and lists the results as follows:

    a. Description of equipment to be tested.
    b. Discrepancies.
    c. Temperature difference between the area of concern and the reference area.
    d. Probable cause of temperature difference.
    e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
    f. Identify load conditions at time of inspection.
    g. Provide photographs and thermograms of the deficient area.

4. Act on inspection results in accordance with the recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

END OF SECTION 261323

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panelboards.
2. Disconnecting and overcurrent protective devices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other requirements applicable to the Work for electrical, communications, and electronic safety and security systems on Project, including wiring methods.
2. Section 260529 "Hangers and Supports for Electrical Systems" specifies concrete bases and supports for panelboards installed by this Section.
3. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
4. Section 260573 "Power System Studies" specifies short-circuit current studies, overcurrent protective device coordination studies, and arc-flash hazard analysis studies.
5. Section 262813 "Fuses" specifies fuses and spare-fuse cabinets installed by this Section.
6. Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits" specifies Type 1 and Type 2 surge protective devices installed by this Section.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Submit the following:

1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

B. Shop Drawings: For each panelboard and related equipment:

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Key interlock scheme drawing and sequence of operations.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Spare parts.

B. Special tools.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation in accordance with NECA 407.

1.7 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Products or components listed and labeled in accordance

with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Comply with NEMA PB 1.

D. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
    a. Indoor Dry and Clean Locations: UL 50E, Type 1.
2. Height: 7 ft maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
4. Finishes:
    a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

E. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
    a. Plating must run entire length of bus.
    b. Bus must be fully rated for entire length.
2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations must allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with lug on neutral bar for each pole in panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with lug on bar for each pole in panelboard.

G. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

H. Panelboard Short-Circuit Current Rating:

1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.

    a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2.2 PANELBOARDS

A. Distribution Panelboard :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABB, Electrification Business
    b. Siemens Industry, Inc., Energy Management Division
    c. Square D; Schneider Electric USA

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

    a. Distribution Type Panelboards: UL 67 and NEMA PB 1.

4. Standard Features:

    a. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

        1) For doors more than 36 inch high, provide two latches, keyed alike.

    b. Mains: Circuit breaker.

        1) Location: Convertible between top and bottom.
        2) Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

    c. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller:
    d. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

5. Other Available Features Required by Project:

    a. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
    b. Do not mount neutral bus in gutter.

B. Lighting and Appliance Branch-Circuit Panelboard:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABB, Electrification Business
    b. Siemens Industry, Inc., Energy Management Division
    c. Square D; Schneider Electric USA

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

    a. Lighting and Appliance Branch-Circuit Type Panelboards: UL 67 and NEMA PB 1.

4. Standard Features:

    a. Mains: Circuit breaker.

        1) Location: Top.

    b. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

5. Other Available Features Required by Project:

    a. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
    b. Do not mount neutral bus in gutter.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, [][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:]

1. [ABB, Electrification Business]
2. []
3. [Siemens Industry, Inc., Energy Management Division]
4. [Square D; Schneider Electric USA]

B. MCCB: Comply with UL 489, with series-connected rating interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A

ground-fault protection (6 mA trip).

4. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
    h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 A must have interchangeable rating plugs or electronic adjustable trip units.

2.4 MAINTENANCE MATERIAL ITEMS

A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents.
    1. Keys: Two spares for each type of panelboard cabinet lock.
    2. Circuit Breakers Including GFCI and GFPE Types: Two spares for each panelboard.

B. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents.
    1. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
    2. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards in accordance with NECA 407 and NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 407 and NEMA PB 1.1.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Equipment Mounting:
    a. Attach panelboard to vertical finished or structural surface behind panelboard.
    b. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
2. Mount top of trim 7.5 ft above finished floor unless otherwise indicated.
3. Mount panelboard cabinet plumb and rigid without distortion of box.
4. Install overcurrent protective devices not already factory installed.
    a. Set field-adjustable, circuit-breaker trip ranges.
    b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
5. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
6. Install filler plates in unused spaces.
7. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
8. Mount spare fuse cabinet in accessible location.

D. Interfaces with Other Work:

1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components.

B. Install warning signs.

C. Panelboard Nameplates: Label each panelboard with nameplate.

D. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

E. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

F. Circuit Directory:

1. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

    a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

2. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

A. Administrant for Low-Voltage Electrical Tests and Inspections:

1. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

1. Include certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies

detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonrenewable cartridge fuses.
2. Spare-fuse cabinets.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
2. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.
3. Section 260573 "Power System Studies" specifies coordination studies, arc-flash hazard analysis, warning labels, and circuit-breaker trip ranges referenced by this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra stock material.

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 NONRENEWABLE CARTRIDGE FUSES

A. Class RK1 Nonrenewable Cartridge Fuse:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Bussmann, an Eaton business
    b. Edison; a brand of Bussmann by Eaton
    c. Littelfuse, Inc.

2. Standard Features:

    a. NEMA FU 1, Class RK1, 200 kA(sym) interrupt rating, current limiting, sizes up to 600 A, 600 V(ac), 8 to 10 s minimum time-delay at 500 percent, with rejection feature.

        1) Select ferrule terminals or knife blade terminals to match equipment where fuse is installed.

B. Class RK5 Nonrenewable Cartridge Fuse:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Bussmann, an Eaton business
    b. Edison; a brand of Bussmann by Eaton
    c. Littelfuse, Inc.

2. Standard Features:

    a. NEMA FU 1, Class RK5, 200 kA(sym) interrupt rating, current limiting, sizes up to 600 A, 600 V(ac), 8 to 10 s minimum time-delay at 500 percent, with rejection feature.

        1) Select ferrule terminals or knife blade terminals to match equipment where fuse is installed.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.

2. Finish: Gray, baked enamel.
3. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

2.4 MAINTENANCE MATERIAL ITEMS

A. Extra Stock Material: Furnish to Owner extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FUSES

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Maintenance: NFPA 70B.
3. Electrical Safety: NFPA 70E.
4. Fuse Applications: NECA NEIS 420.

C. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

D. Install spare-fuse cabinet(s) in location as indicated in the field by Owner.

E. Interfaces with Other Work:

1. Identification: Provide labels for spare fuse cabinet.

a. Legend: "SPARE FUSES" in 1-1/2 inch high letters on exterior of door.

2. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with results of coordination study and arc-flash hazard analysis.

END OF SECTION 262813

SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual motor controllers.
2. Enclosed reduced-voltage motor controllers.
3. Combination full-voltage magnetic motor controllers.
4. Enclosures.
5. Accessories.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SCPD: Short-circuit protective device.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Manual motor controllers.
2. Enclosed full-voltage magnetic motor controllers.
3. Enclosures.
4. Accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.

2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. File number for listing by qualified electrical testing laboratory.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.

    a. Listing document proving Type 2 coordination.

7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by qualified electrical testing laboratory recognized by authorities having jurisdiction.

D. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' published instructions.

B. Field Reports:

1. Manufacturer's field reports for field quality-control support.
2. Field reports for infrared scanning.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing motor controllers, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
3. Power Contacts: Furnish three spares for each size and type of magnetic

contactor installed.

4.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W per controller connect factory-installed space heaters to temporary electrical service.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.

C. NEMA Compliance: Fabricate motor controllers to comply with NEMA ICS 2.

2.2 MANUAL MOTOR CONTROLLERS

A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Standard: Comply with NEMA ICS 2, general purpose, Class A.
2. Configuration: Nonreversing
3. Surface mounting.

B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. ABB, Motion Business
c. Rockwell Automation, Inc**.**
d. Siemens Industry, Inc., Energy Management Division

e. Square D; Schneider Electric USA

2. Configuration: Nonreversing
3. Overload Relays:

a. Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push-button; bimetallic type; melting alloy type.
b. NEMA ICS 2, bimetallic class as schedule on Drawings.

C. Integral Horsepower Manual Controllers (IHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB, Electrification Business
b. ABB, Motion Business
c. Rockwell Automation, Inc.
d. Siemens Industry, Inc., Energy Management Division
e. Square D; Schneider Electric USA

2. Configuration: Non-reversing
3. Overload Relays:

a. Inverse-time-current characteristics; NEMA ICS 2, Class 10tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push-button; bimetallic type; melting alloy type.
b. NEMA ICS 2, bimetallic class as scheduled on Drawings.

2.3 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

A. Description: Across-the-line start, electrically held, for nominal system voltage of 600 V(ac) and less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABB, Electrification Business
2. ABB, Motion Business
3. Rockwell Automation, Inc.
4. Siemens Industry, Inc., Energy Management Division
5. Square D; Schneider Electric USA

C. Configuration: Nonreversing

D. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.

1. Operating Voltage: Manufacturer's standard, unless indicated.

E. Control Power:

1. For on-board control power, obtain from line circuit or from integral CPT. The CPT must have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
   a. Spare CPT Capacity as Indicated on Drawings:

F. Overload Relays:

1. Thermal Overload Relays:
   a. Inverse-time-current characteristic.
   b. Class 10 tripping characteristic.
   c. Heaters in each phase must be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
   d. Ambient compensated.
   e. Automatic resetting.

2.4 COMBINATION REDUCED-VOLTAGE MOTOR CONTROLLERS

A. Description: Factory-assembled, combination reduced-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, and SCPD and OCPD, in a single enclosure.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABB, Electrification Business
2. Rockwell Automation, Inc.
3. Siemens Industry, Inc., Energy Management Division
4. Square D; Schneider Electric USA

C. Configuration:

1. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.

D. Contactor Coils: Pressure-encapsulated type.

1. Operating Voltage: Manufacturer's standard, unless indicated.

E. Control Power: 24 V(ac); obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
   1. Spare CPT Capacity: 50 VA.

F. Overload Relays:

1. Thermal Overload Relays: Melting alloy type.

    a. Inverse-time-current characteristic.
    b. Class 10 tripping characteristic.
    c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

G. Digital Communication Module: TIA-485 Modbus, RTU protocol, 2-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous RMS current each phase, and three-phase average.
2. Voltage: L-L for each phase, L-L three-phase average, L-N each phase and L-N three-phase average - RMS.
3. Active Energy (kWh): Three-phase total.
4. Power Factor: Each phase and three-phase total.

H. Fusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.5 ENCLOSURES

A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.

B. The construction of the enclosures must comply with NEMA ICS 6.

2.6 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push-Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.

    a. Push-Buttons: As indicated in the controller schedule.
    b. Pilot Lights: As indicated in the controller schedule.

2.7 SOURCE QUALITY CONTROL

A. Product Data: Prepare and submit catalog cuts, brochures, diagrams, schedules, and performance data illustrating size, physical appearance, and other characteristics of product.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.

C. Maintain minimum clearances and workspace at equipment in accordance with manufacturer's published instructions and NFPA 70.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Controller Nameplates: Baked enamel signs, Metal backed butyrate signs, Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.
    d. Verify the unit is clean.

e. Inspect contactors:

1) Verify mechanical operation.
2) Verify contact gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.

f. Motor-Running Protection:

1) Verify overload element rating is correct for its application.
2) If motor-running protection is provided by fuses, verify correct fuse rating.

g. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:

a. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
b. Test motor protection devices in accordance with manufacturer's published data.
c. Test circuit breakers as follows:

1) Operate the circuit breaker to ensure smooth operation.
2) For adjustable circuit breakers, adjust protective device settings in accordance with the coordination study. Comply with coordination study recommendations.

d. Perform operational tests by initiating control devices.

4. System Function Tests:

a. System function tests must prove the correct interaction of sensing, processing, and action devices. Perform system function tests after electrical tests have been completed and all components have passed specified tests.

1) Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2) Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3) Verify the correct operation of sensing devices, alarms, and indicating devices.

B. Nonconforming Work:

1. Motor controller will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

END OF SECTION 262913.03

SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type 2 surge protective devices (SPDs).
2. Enclosures.
3. Conductors and cables.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. In: Nominal discharge current.

B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.

C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.

D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient over voltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).

E. SCCR: Short-circuit current rating.

F. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

G. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include electrical characteristics, specialties, and accessories for SPDs.

b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:

1) Tested values for VPRs.
2) In ratings.
3) MCOV, type designations.
4) OCPD requirements.
5) Manufacturer's model number.
6) System voltage.
7) Modes of protection.

B. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.5 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Five year(s) from date of Substantial Completion, for labor, materials, and equipment.
2. Follow-On Extended Warranty Period: 10 year(s) from date of Substantial Completion, for materials only, f.o.b. the nearest shipping point to Project site.

PART 2 - PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABB, Electrification Business
2. Advanced Protection Technologies Inc. (APT)
3. ALLTEC LLC
4. Citel, Inc.
5. Intermatic, Inc
6. Leviton Manufacturing Co., Inc.
7. Liebert; Vertiv Holdings Co.
8. Mersen USA
9. Schneider Electric USA, Inc.
10. Siemens Industry, Inc., Energy Management Division
11. SSI, an ILSCO Company

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. General Characteristics:

1. Reference Standards: UL 1449, Type 2; UL 1283.
2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits must not exceed the following:

    a. Line to Neutral: 1200 V for 480Y/277 V.
    b. Line to Ground: 1200 V for 480Y/277 V.
    c. Neutral to Ground: 1200 V for 480Y/277 V.
    d. Line to Line: 2000 V for 480Y/277 V.

5. SCCR: Equal or exceed 100 kA.
6. In Rating: 20 kA.

D. Options:

1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V(ac) for remote monitoring of protection status.
4. Include surge counter.

2.2 ENCLOSURES

A. Indoor Enclosures: Type 1.

2.3 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Do not splice and extend SPD leads unless specifically permitted by

manufacturer.
2. Do not exceed manufacturer's recommended lead length.
3. Do not bond neutral and ground.

C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's installation requirements.

B. Nonconforming Work:

1. SPDs that do not pass tests and inspections will be considered defective.
2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luminaires.
2. Luminaire fittings.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" specifies wiring connections installed by this Section.
3. Section 260529 "Hangers and Supports for Electrical Systems" specifies channel and angle supports installed by this Section.
4. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
5.

1.2 DEFINITIONS

A. Correlated Color Temperature (CCT): The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.

B. Color Rendering Index (CRI): The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.

C. IES: Illuminating Engineering Society.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Luminaires: Include the following additional information:

a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.

b. Product Certificates: Include product certificates stating compliance with standards listed below, signed by manufacturer or fabricator.

1) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with current accreditation under National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
2) Testing Agency Certified Data: For luminaires indicated on Lighting Fixture Schedule on the Drawings, photometric data certified by qualified independent testing laboratory. Photometric data for remaining luminaires must be certified by manufacturer.

c. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
d. Include operating characteristics, electrical characteristics, and furnished accessories.
e. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.
f. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
g. Include photometric data and adjustment factors obtained from qualified laboratory tests.
h. Include manufacturer's sample warranty language.

2. Luminaire Fittings: Include the following additional information:

a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.

b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
c. Include operating characteristics, electrical characteristics, and furnished

accessories.

d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 LUMINAIRES

A. Surface-Mounted Luminaire :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Columbia Lighting; brand of GE Current, a Daintree company; American Industrial Partners (AIP)
   b. Cooper Lighting Solutions; Signify North America Corp.
   c. Hubbell Lighting; brand of Hubbell Electrical Solutions; Hubbell Incorporated
   d. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Listing Criteria:
   a. LED Luminaires: UL 1598.
3. Standard Features:
   a. Openings: Doors, frames, and access panels must operate smoothly, not leak light under operating conditions, and permit relamping without use of tools or parts falling from enclosure.
   b. Nominal Operating Voltage: 277 V(ac).
   c. Nominal Luminaire Operating Power Rating: 20 to 60 W.
   d. CRI: 80+.
   e. Ballast or Driver Location: Internal.
   f. Materials:
      1) Enclosure: ASTM B209/B209M extruded-aluminum housing and heat sink; free of sharp edges and burrs.
      2) Enclosure Ingress Protection Rating: UL 50E Type 1 or IEC 60529 IP20.
      3) Lenses, Diffusers, and Globes:
         a) Fixed Adjustable lens.
         b) Spot light distribution.
         c) Lens Thickness: Not less than 0.125 inch unless otherwise indicated.

g. LED Luminaires:

1) Output Intensity: Not less than 575 lm.
2) Efficacy: Not less than 75 lm/W.
3) Rated Life: 35 000 hours to L70.
4) CCT: Three-step selectable 3000-4000-5000 K.

4. Other Available Features Required by the Project:

a. Mounting Hardware: Pendant-mounted; with integral mounting provisions.
b. Mounting Height: As noted in the drawings.
c. Finishes:

1) Enclosure: painted finish.

2.3 LUMINAIRE FITTINGS

A. Luminaire Support Accessories:

1. Other Available Features Required by the Project:

a. Hook Hangers: Integrated assembly matched to luminaire, supply voltage, and equipment with threaded attachment, cord, and locking-type plug.
b. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage wire supports adjustable to10 ft in length.
c. Aircraft Cables: 5/32 inch diameter aircraft cable supports adjustable to10 ft in length.
d. Single-Stem Hangers: 1/2 inch nominal diameter steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
e. Rod Hangers: 3/16 inch nominal diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LIGHTING

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
3. Installation of Indoor Lighting Systems: NECA NEIS 500.
4. Installation of Industrial Lighting Systems: NECA NEIS 502.
5. Installation of Luminaires, Lampholders, and Lamps: Article 410 of NFPA 70.

C. Special Installation Techniques:

1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
2. Install luminaires at height as indicated on the Drawings.
3. Coordinate layout and installation of luminaires with other construction.
4. Suspended Luminaire Support:

   a. Ceiling Mount:

      1) Hook hangers.
      2) Two wires.
      3) Two aircraft cables.

   b. Pendants and Rods: Where longer than 48 inch, brace to limit swinging.
   c. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
   d. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and tubing or rod wire support for suspension for each unit length of luminaire chassis, including one at each end.
   e. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

D. Systems Integration: Integrate lighting control devices and equipment with electrical power connections for operation of luminaires as specified.

3.3 FIELD QUALITY CONTROL OF LIGHTING

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.

B. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 PROTECTION

A. After installation, protect lighting equipment from construction activities. Remove and

replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 265000