

Lake Fort Smith and Lee Creek Fluoride Feed Systems

City of Fort Smith, Arkansas

14-10-C1

Issued For Bid

Project No. 81174

June 2015



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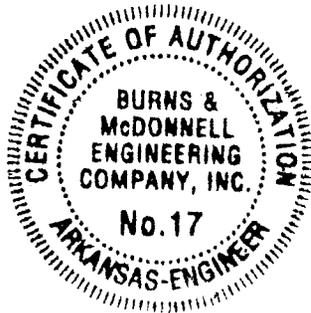
City of Fort Smith, Arkansas
Lake Fort Smith and Lee Creek Fluoride Feed Systems
14-10-C1
Burns & McDonnell Project No. 81174

DOCUMENT 000107 - INDEX AND CERTIFICATION PAGE

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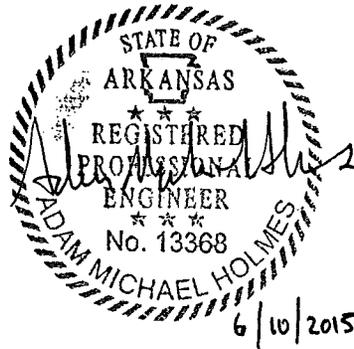


Burns & McDonnell

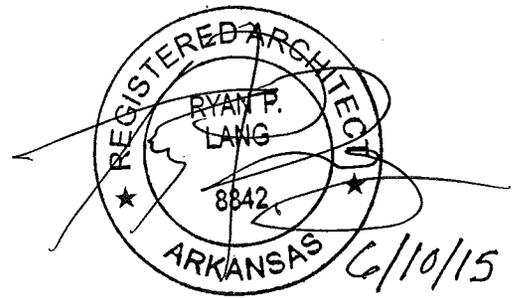
CERTIFICATIONS



Dana Bruner, P.E.
Sections 001116 to 007200,
and Division 1 and 46



Adam Holmes, P.E.
Division 3



Ryan Lang, R.A.
Divisions 4, 7, 8,
9, and 10



Judy Macoubrie, P.E.
Division 22 and 23



Shawn Taylor, P.E.
Divisions 26, 28,
40, and 46



Steven Hansen, P.E.
Division 31 and 32

Advertisement for Bids

City of Fort Smith, Arkansas

Separate sealed bids for **Lake Fort Smith and Lee Creek Fluoride Feed Systems, Project Number 14-10-C1**, will be received by the City of Fort Smith, Arkansas, **at the Office of the Director of Utilities until 2:00 pm (Local Time), Tuesday, June 30th, 2015** and then at said office publicly opened and read aloud. Bids shall be addressed **“Director of Utilities, City of Fort Smith, Utility Department, 3900 Kelley Highway, Fort Smith, Arkansas 72904”** and shall be labeled bid for **Lake Fort Smith and Lee Creek Fluoride Feed Systems, Project Number 14-10-C1**. Bidders are to include their Arkansas License number on the outside of their sealed bid. **Bids shall only be received from Registered Bidders.**

The information for Bidders, Form of Bid, Form of Contract, Plans, and Specifications, and other contract documents may be examined at:

City of Fort Smith
Utility Department
3900 Kelley Highway
Fort Smith, Arkansas 72904
Phone: 479-784-2231
Fax: 479-784-2358

Burns & McDonnell
Toni Hall (816-822-3800)
9201 State Line Road
Kansas City, Missouri 64114

Copies of the Bid Document may be obtained for bidding purposes from Burns & McDonnell upon prepayment of a nonrefundable deposit as follows:

Project Manual – Seventy-five Dollars (\$75.00)
Full Sized (24”x36”) Contract Drawings – One Hundred Fifty Dollars (\$150.00)
Half Sized (12”x18”) Contract Drawings – Seventy-five Dollars (\$75.00)
CD with PDF files of the Project Manual and Contract Drawings – Fifteen Dollars (\$15.00)

Burns & McDonnell
Toni Hall (816-822-3800)
9201 State Line Road
Kansas City, Missouri 64114

The owner reserves the right to waive any informalities or to reject any or all bids.

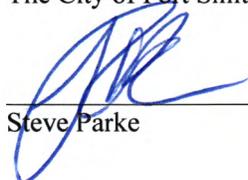
Each bidder must deposit with his bid, security in the amount, form and subject to the conditions provided in the Information for Bidders.

All bidders must be licensed under the terms of Act 150 of the 1965 Acts of the Arkansas Legislature, including subsequent amendments, and considered by the Arkansas Contractors Licensing Board to be classified as a General Contractor for the classification required to perform the work identified as part of the project.

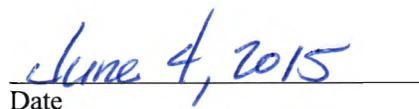
The City of Fort Smith encourages participation of small, minority, and woman owned business enterprises in the procurement of goods, services, and construction, either as a general contractor or subcontractor.

No bidder may withdraw his bid within 60 days after the actual date of the opening thereof.

The City of Fort Smith is an EOE M/F.



Steve Parke



Date

DOCUMENT 001116 - INVITATION TO BID

Burns & McDonnell Engineering Company
P.O. Box 419173
Kansas City, Missouri 64141-6173

Project Name: Lake Fort Smith and Lee Creek Fluoride Feed Systems
Contract No.: 14-10-C1
Date: June 14th, 2015

DESCRIPTION OF WORK OF THIS CONTRACT

You are invited to bid on a general contract. The Contract provides for the construction of fluoride storage and feed facilities at the Lake Fort Smith Water Treatment Plant (WTP) near Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas.

BID INFORMATION

Bids will be received by the City of Fort Smith, Arkansas (the Owner) until 2:00 p.m., local time, June 30th, 2015. Bids received after this time will not be accepted. Bids will be received at the following location:

1. Until 2:00 pm on June 30th, 2015:
Utility Department Administration Office
3900 Kelley Highway
Fort Smith, Arkansas 72904
Attn: Steve Parke, Director of Utilities

Copies of the Bid Documents may be obtained for bidding purposes from Burns & McDonnell Engineering Company upon prepayment of a nonrefundable deposit as follows:

- Project Manual – Seventy-five Dollars (\$75.00)
- Full Sized (24" x 36") Contract Drawings – One Hundred Fifty Dollars (\$150.00)
- Half Sized (12" x 18") Contract Drawings – Seventy-five Dollars (\$75.00)
- CD with PDF files of the Project Manual and Contract Drawings – Fifteen Dollars (\$15.00)

Deposits are refundable as provided in the Instructions to Bidders. Bid Documents may be obtained at the following Issuing Office:

Burns & McDonnell
Toni Hall (816-822-3800)
9201 State Line Road
Kansas City, Missouri 64114

A prebid conference will be held as stated in the Instructions to Bidders.

Bids will be received on a lump sum basis.

DOCUMENT 001116 – INVITATION TO BID: continued

Bidders shall be qualified to do business and licensed in accordance with all applicable laws of the state and local governments where the Project is located.

Bids received from Bidders who are not recorded by Burns & McDonnell Engineering Company as having received the Bid Documents will not be opened.

Prequalification of Bidders will not be required; however, the Bidder shall submit DOCUMENT 001153 Bidders Qualification Statement with the Bid. Owner will evaluate Bidders in accordance with the Instructions to Bidders.

Bid security in the form of a certified or bank cashier's check or a Bid Bond in the amount of 5% of total Bid price shall accompany each Bid in accordance with the Instructions to Bidders.

Bids shall be in accordance with the Bid Documents on file with Owner and Engineer.

Bids will be publicly opened and read aloud immediately after time stated above.

COMPLETION

Completion time shall be as follows:

The Work shall be Substantially Completed on or before January 30, 2016, and completed and ready for final payment in accordance with the GENERAL CONDITIONS on or before February 29, 2016.

ADDITIONAL PROVISIONS

The Bid shall be conditioned upon compliance with all labor related requirements including the regulations and stipulations concerning equal employment opportunity and minimum wage rates.

Bidders shall be qualified to do business and licensed under the terms of Act 150 of the 1965 Acts of the Arkansas Legislature, including subsequent amendments.

No Bidder may withdraw its Bid within 60 days after the actual date of the opening thereof.

DOCUMENT 001116 – INVITATION TO BID: continued

The City of Fort Smith encourages participation of small, minority, and women owned business enterprises in the procurement of goods, services, and construction, either as a general contractor or subcontractor.

OWNER'S RIGHT TO REJECT

The Owner reserves the right to reject any or all Bids and to waive irregularities therein, and all Bidders shall agree that such rejection shall be without liability on the part of the Owner for any damage or claim brought by any Bidder because of such rejections, nor shall the Bidders seek any recourse of any kind against the Owner because of such rejections. The filing of any Bid in response to this invitation shall constitute an agreement of the Bidder to these conditions.

OWNER

The City of Fort Smith, Arkansas

By _____

Mr. Steve Parke
Director of Utilities

END OF DOCUMENT 001116

DOCUMENT 001153 - BIDDER'S QUALIFICATION STATEMENT

Project Name: Lake Fort Smith and Lee Creek Fluoride Feed Systems

City Project No.: 14-10-C1

SUBMITTED TO:

City of Fort Smith, Arkansas
Utility Department Administrative Office
3900 Kelley Highway
Fort Smith, Arkansas 72904

SUBMITTED BY:

Company _____
Name _____
Address _____
Principal Office _____
Corporation, partnership, individual, joint
venture, other _____
Contractor license number, and state

EXPERIENCE STATEMENT

1. Bidder has been engaged as a General Contractor in construction for _____ years and has performed work of the nature and magnitude of this Contract for _____ years. Bidder has been in business under its present name for _____ years.
2. Bidder now has the following bonded projects under contract: (On a separate sheet, list project name, owner, engineer/architect, amount of contract, surety, and estimated completion date.)
3. Bidder has completed the following threecontracts consisting of work similar to that proposed by this Contract: On a separate sheet, list project name, owner, engineer/architect, amount of contract, surety, and date of completion, and percentage of the cost of the Work performed with Bidder's own forces.
4. Has Bidder ever failed to complete any project? If so, state when, where, and why.

DOCUMENT 001153 – BIDDER’S QUALIFICATION STATEMENT: continued

5. Bidder normally performs the following work with its own forces:

6. Construction experience of key individuals in the organization is as follows (Attach resumes of proposed Project Manager and Field Superintendant for Lake Fort Smith and Lee Creek Fluoride Feed Systems project):

7. In the event the Contract is awarded to Bidder, the required surety Bonds will be furnished by the following surety company and name and address of agent:

FINANCIAL STATEMENT

Bidder possesses adequate financial resources as indicated by the following:

1. If requested by Owner, Bidder shall provide documents indicating financial ability of the Bidder as specified in DOCUMENT 002113 to perform the Work.
- a. Name of firm preparing financial statement and date thereof.

If financial statement is not for identical organization named herein, explain relationship and financial responsibility of the organization furnished.

2. Current Judgments: The following judgements are outstanding against Bidder:

| | <u>Judgment Creditors</u> | <u>Where Docketed and Date</u> | <u>Amount</u> |
|----|---------------------------|--------------------------------|---------------|
| a. | _____ | _____ | \$_____ |
| b. | _____ | _____ | \$_____ |

DOCUMENT 001153 – BIDDER’S QUALIFICATION STATEMENT: continued

Bidder hereby represents and warrants that all statements set forth herein are true and correct.

Date _____, 2015

(OFFICIAL SEAL)

Name of Organization:

By _____

Title _____

(If Bidder is a partnership, the partnership name shall be signed, followed by the signature of at least one of the partners. If Bidder is a corporation, the corporate name shall be signed, followed by the signature of a duly-authorized officer and with the corporate seal affixed).

END OF DOCUMENT 001153

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS

ARTICLE 1 - INTRODUCTORY INFORMATION

1.01 DEFINED TERMS:

- A. Terms used in these Instructions to Bidders and which are defined in the GENERAL CONDITIONS, have the meanings assigned to them in the GENERAL CONDITIONS.
- B. Bid Documents shall include the following:
 - 1. Bidding Requirements:
 - a. Invitation to Bid.
 - b. Instructions to Bidders.
 - c. Bidder's Qualification Statement.
 - d. Bid Form.
 - e. Bid Bond.
 - 2. Contract Forms:
 - a. Agreement.
 - b. Arkansas Performance and Payment Bond.
 - c. Maintenance Bond.
 - d. Certificate of Compliance With All Laws and Regulations Regarding Workers Who Are Non-Citizens of the United States.
 - e. Certificate of Owner's Attorney.
 - 3. Contract Conditions:
 - a. General Conditions.
 - b. Labor-Related Regulations.
 - 4. Specifications.
 - 5. Drawings.
 - 6. Addenda issued prior to receipt of Bids.
- C. Certain additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof.
 - 1. Bidder - one who submits a Bid directly to Owner as distinct from a sub-bidder, who submits a bid to a Bidder.
 - 2. Issuing Office - the office from which the Bid Documents are to be issued and where the bidding procedures are to be administered.
 - 3. Successful Bidder - the lowest, responsible, and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

1.02 COPIES OF BID DOCUMENTS:

- A. Complete sets of the Bid Documents in the number and for the deposit sum (if any) stated in the Invitation to Bid, may be obtained from the Issuing Office.
- B. Complete sets of Bid Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.
- C. Owner and Engineer in making copies of Bid Documents available on the above terms do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS: continued

1.03 QUALIFICATION OF BIDDERS:

- A. Bidders are required to complete DOCUMENT 001153 – Bidder’s Qualification Statement and submit with bid. Prequalification statements are not required. Owner will, however, evaluate the Bidder’s qualifications following the opening of Bids. Evaluation criteria considered will include, but not be limited to:
 - 1. Financial responsibility.
 - 2. Experience and performance records on similar work.
 - 3. Ability to supply construction equipment and personnel to complete the Work within the Contract Time.
 - 4. Evidence of Bidder to do business in the state where the Project is located, or covenant to obtain such qualifications prior to award of the Contract.
- B. Bidders may be requested to submit financial statement subsequent to the Bid opening. Such statements shall be submitted to Owner within 3 days after being so requested.
- C. Only those Bids will be considered which are submitted by Bidders who show satisfactory completion of work of type and size comparable to the Work required by these Bid Documents.
 - 1. A list of comparable projects, including pertinent information and identification of the owners, shall be submitted with the Bid.
- D. See ARTICLE 5 - AWARD OF CONTRACT herein for additional requirements after opening of Bids.

1.04 EXAMINATION OF CONTRACT DOCUMENTS AND SITE:

- A. Before submitting a Bid, it is the responsibility of each Bidder:
 - 1. To thoroughly examine the Contract Documents and other related data identified in the Bid Documents including "technical data" referred to below.
 - 2. To visit the Site to become familiar with and satisfy Bidder as to the general, local, and Site conditions that may in any manner affect cost, progress, and performance of the Work.
 - 3. To consider federal, state, and local laws, ordinances, rules, and regulations that may in any manner affect cost, progress, performance, and furnishing of the Work.
 - 4. To study and carefully correlate Bidder’s knowledge and observations with the Contract Documents and such other related data.
 - 5. To promptly notify Engineer of all conflicts, errors, ambiguities, or discrepancies which Bidder has discovered in or between the Contract Documents and such other related documents.
- B. Before submitting a Bid, each Bidder will be responsible to obtain such additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site or otherwise, which may affect cost, progress, performance, and furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder, including safety precautions and programs incident thereto or which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents. This shall include local shipping facilities and availability of lands if applicable.
- C. Access to the Site:
 - 1. On request, Owner will provide each Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as each Bidder deems necessary for submission of its Bid. Bidder must fill all holes, clean up, and restore the

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS: continued

Site to its former conditions upon completion of such explorations, investigations, tests, and studies.

- a. Bidder may access Sites Mondays through Fridays from 7:30 a.m. until 4:00 p.m. by appointment only. Appointment may be scheduled by contacting Mr. Steve Floyd at 479-784-2231.
 2. The lands upon which the Work is to be performed, rights-of-way, and easements for access thereto and other lands designated for use by Bidder in performing the Work are identified in the Bid Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of Materials and Equipment to be incorporated in the Work are to be obtained and paid for by Bidder. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bid Documents.
- D. Subsurface Information:
1. Certain subsurface information has been obtained at, or in the vicinity of, the Site of the Work.
 2. Copies of such subsurface information will be issued only to prospective Bidders who request such subsurface information and sign a receipt therefor by contacting the Issuing Office.
 3. There is no express or implied guarantee as to the accuracy or completeness of the subsurface information, nor of the interpretation thereof by the Owner, the Engineer, or any of their representatives.
 4. The subsurface information or copies thereof do not form a part of this or any contract document issued by the Owner or Engineer.
- E. The submission of a Bid will constitute an incontrovertible representation by the Bidder that it has complied with every requirement of this paragraph "Examination of Contract Documents and Site," and that the Bid Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

1.05 INTERPRETATIONS, MODIFICATIONS, AND ADDENDA:

- A. Any Bidder who discovers ambiguities, inconsistencies, or errors or is in doubt as to the meaning or intent of any part of the Bid Documents shall promptly request Engineer to provide an interpretation. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bid Documents.
 1. Requests for interpretation by Engineer shall be received via email to the following:
 - a. Dana Bruner at dlbruner@burnsmcd.com
- B. Addenda may also be issued to modify the Bid Documents as deemed advisable by Owner or Engineer.
- C. Because of the time required to publish and deliver Addenda, questions received less than seven calendar days prior to the date of the bid opening may not be answered.
- D. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

1.06 LABOR-RELATED REGULATIONS:

- A. The Bidder's attention is directed to the special rules, regulations, and stipulations as described in:
 1. Attachment A – Arkansas Prevailing Wage Determination Number AR150163 as attached to this Document.

ARTICLE 2 - BASIS OF BIDDING

2.01 SPECIFIED EQUIPMENT AND MATERIALS:

- A. The Contract, if awarded, will be on the basis of Equipment and Materials specified or described in the Bid Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bid Documents that a substitute or "or-equal" item of Equipment or Material may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in the GENERAL CONDITIONS and may be supplemented in the General Requirements.
- B. Electronic Equipment Compliance:
 - 1. All equipment, devices, items, systems, software, hardware or firmware provided under this Contract shall be warranted as electronically compliant, meaning that they shall properly, appropriately, and consistently function and accurately process date and time data including without limitation: calculating, comparing, and sequencing. This warranty supercedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

2.02 INDIRECT COSTS:

- A. Taxes:
 - 1. All applicable sales, use, compensating, or other taxes to be paid or withheld by Bidder, now imposed by any taxing authority, on Equipment and Materials to be incorporated in the Work, and on any or all other cost items entering into the Contract Price, shall be included in the Bid price.
 - 2. The Bidder shall include all such taxes except those on Equipment and Materials, if any, furnished by Owner or others, and Bidder shall furnish taxing authorities any information or reports pertaining thereto as required.
 - 3. Owner is not exempt by law from taxes.
- B. The cost of all construction licenses, building and other permits, and governmental inspections required by public authorities for performing the Work, which are applicable at the time Bids are opened and which are not specified to be obtained by Owner, shall be included in the Bid price.
- C. The cost of all royalties and license fees on Equipment and Materials to be furnished and incorporated in the Work shall be included in the Bid price.
- D. Tests, inspections, and related activities called for throughout the Bid Documents are a responsibility of Bidder unless specified otherwise. The Bid shall include all costs arising from such responsibility.
- E. The cost of all electrical, water, gas, telephone, sanitary, and similar facilities and services required by Bidder in performing the Work shall be included in the Bid price unless specified otherwise.

2.03 SUBCONTRACTORS:

- A. No Bid shall be based upon aggregate of Subcontractors performing more than 60% of the total Work.

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS: continued

- B. The experience, past performance, and ability of each proposed Subcontractor will be considered in the evaluations of Bids. Any proposed Subcontractor so requested shall furnish experience statement prior to Notice of Award.
- C. No Bidder shall be required to employ any Subcontractor, other person, or organization against whom Bidder has reasonable objection.

2.04 CONTRACT TIMES:

- A. The number of days within which, or the dates by which, the Work is to achieve Substantial Completion and also final completion and be ready for final payment shall be set forth in the Bid Form and will be stated in the Agreement.
- B. Provisions for liquidated damages, if any, are as set forth in the Agreement.

ARTICLE 3 - BIDDING PROCEDURE

3.01 PREPARATION OF BID:

- A. One copy of the Project Manual shall be used for the Bid. The other copy (copies) of the Project Manual and the Contract Drawings may be retained by the Bidder.
- B. The Project Manual shall not, for any reason, be unbound.
- C. The Bid Form shall be filled out in detail in black ink and signed by the Bidder.
- D. Bids by partnerships shall be executed in the partnership name and signed by a partner whose title shall appear under his signature, and the official address of the partnership shall be shown below the signature.
- E. Bids by corporations shall be executed in the corporate name by the president or a vice president or other corporate officer accompanied by evidence of authority to sign, and the corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.
- F. Names of all persons signing shall be printed below their signatures.
- G. A power of attorney shall accompany the signature of anyone not otherwise authorized to bind the Bidder.
- H. The Bid shall contain an acknowledgement of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form. The last page of each addendum shall be attached to the bid.
- I. The address to which communications regarding the Bids are to be directed shall be shown.

3.02 METHOD OF BIDDING:

- A. Bids will be received on a Lump Sum basis as set forth in the Bid Form.
- B. Firm Bids are required.

3.03 SUBCONTRACTORS INFORMATION SUBMITTED WITH BID:

- A. Bid shall include a list of major Subcontractors the Bidder expects to use in the Work. Those to be included shall be as listed in the Bid Form.

3.04 MANUFACTURERS SUBMITTED WITH BID:

- A. Bid shall include list of major Equipment manufacturers the Bidder expects to use in the Work. Those to be included shall be as listed in the Bid Form.

3.05 BID SECURITY:

- A. Each Bid shall be accompanied by Bid security, payable to Owner, of the amount stipulated in the Invitation to Bid.

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS: continued

- B. The required security shall be in the form of a certified or bank cashier's check or a Bid Bond on the form attached (004313).
- C. Bid Bond shall be executed by a surety meeting the requirements set forth for "Surety Bonds" in the GENERAL CONDITIONS.
- D. Bid security of the Successful Bidder will be retained until Bidder has executed the Agreement and furnished the required surety Bonds as set forth in the GENERAL CONDITIONS, whereupon Bid security will be returned. If the Successful Bidder fails to execute the Agreement and furnish the surety Bonds within 15 days after the date of Notice of Award, Owner may annul the Notice of Award, and the Bid security of that Bidder will be forfeited to Owner.
- E. The Bid security of any Bidder whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 10 days after the Effective Date of the Agreement and the required surety Bonds furnished, or the 61st day after the Bid opening. Bid security of other Bidders will be returned within 10 days of the Bid opening.

3.06 SUBMISSION OF BID:

- A. Bids shall be submitted at the time and place designated in the Invitation to Bid.
- B. Bid Documents with accompanying Bid security and other required information shall be enclosed in an opaque sealed envelope marked with the following:
 - 1. Project name.
 - 2. Contract title and number.
 - 3. Name and address of Bidder.
 - 4. Arkansas State General Contractor's License Number.
- C. If the Bid is sent by mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "Sealed Bid Enclosed" on the face thereof.

3.07 MODIFICATION OR WITHDRAWAL OF BIDS:

- A. Bids may be modified or withdrawn by an appropriate document duly executed in the manner that Bid must be executed and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.
- B. If, within 24 hours after Bids are opened, any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of his Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work to be provided under the Contract Documents.

ARTICLE 4 - OPENING OF BIDS

4.01 OPENING OF BIDS:

- A. Bids will be opened and unless obviously nonresponsive read aloud publicly at the place where Bids are to be submitted. An abstract of the amounts of the base Bids will be made available to Bidders after the opening of Bids.
- B. All Bids shall remain open for a period of 60 days after Bids are opened, but Owner may, in its sole discretion, release any Bid and return the Bid security at any time prior to that date.

ARTICLE 5 - AWARD OF CONTRACT

5.01 OWNER'S RIGHT TO REJECT BIDS:

- A. Owner reserves the right to reject any or all Bids, including without limitation the rights to reject any or all nonconforming, nonresponsive, unbalanced, or conditional Bids and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. Owner also reserves the right to waive all informalities not involving price, times, or changes in the Work and to negotiate Contract terms with the Successful Bidder. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.
- B. All Bidders must agree that such rejection shall be without liability on the part of the Owner nor shall the Bidders seek any recourse of any kind against the Owner because of such rejections. The filing of any Bid shall constitute an agreement of the Bidder to these conditions.

5.02 EVALUATION OF BIDS:

- A. In evaluating Bids, Owner will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- B. Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted. Owner may also consider the operating costs, maintenance requirements, performance data, and guarantees of Equipment and Materials proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.
- C. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications, and financial ability of the Bidders, proposed Subcontractors, and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.
- D. Owner reserves the right to reject the Bid of any Bidder who does not pass any such evaluation to Owner's satisfaction.
- E. The award of the Contract, if it is awarded, will be to the lowest, responsive, responsible Bidder whose evaluation by Owner indicates to Owner that the award will be in the best interest of Project and Owner.
- F. Any protest of bid award must be made in writing and received by the Utility Department no later than three days after notice of intent to award has been made. Additionally, if the subject contract requires board of directors approval, written protest must be received by the Utility Department no later than five days before the next board of directors meeting at which the recommended bid award will be considered.

5.03 NOTICE OF AWARD:

- A. After considering the basis of award and evaluation of Bids, if the Contract is to be awarded, Owner shall within 60 days after the date of opening Bids notify the Successful Bidder of acceptance of his Bid.

ARTICLE 6 - SIGNING OF AGREEMENT

- 6.01 When Owner gives Notice of Award to Successful Bidder, Engineer will issue the required number of unbound, unsigned counterparts of the Agreement and other Contract Documents to Successful Bidder.
- 6.02 Within 15 days thereafter, Contractor (Successful Bidder) shall sign all copies of the Agreement leaving the dates blank, insert the properly executed Bonds, power of attorney documents, and other required documents in the appropriate places, and deliver all copies to Owner.
- 6.03 Within 10 days thereafter, Owner will execute all copies of the Agreement and insert the Date of Contract in the Agreement, Bonds, and other documents. Owner will provide the executed Contract Documents to Engineer for binding and distribution as required. Each duly executed counterpart will be accompanied by a complete set of Drawings with appropriate identification.

ARTICLE 7 - POLICY REGARDING WORKERS WHO ARE NOT CITIZENS OF THE UNITED STATES

- 7.01 The contractor shall keep fully informed of all federal, state, and local laws, ordinances, and regulations, and all orders and decrees of bodies or tribunals having jurisdiction or authority, which in any manner affect those engaged or employed in the Work required by the Contract Documents, specifically including without limitation, laws and regulations pertaining to the employment of persons who are not citizens of the United States. Further the Contractor shall at all times observe and comply with all such laws, ordinances, regulations, quarantines, orders, and decrees and shall protect and indemnify the Owner and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree. The Contractor shall cause a similar provision to be placed in each subcontract entered into by the Contractor.
- 7.02 The Contractor agrees that the Contractor shall be subject to an administrative penalty of up to five hundred dollars (\$500.00) to be imposed by the Owner for any violation of the foregoing provision or the required certification in the form provided in the Contract Documents. The Contractor shall be entitled to a due process hearing before the City Administrator for the Owner if requested in writing within five (5) working days of the Owner's notification of potential imposition of administrative penalty.
- 7.03 The Contractor shall be required to execute and submit simultaneously with his delivery of the executed contract, the Certificate of Compliance With All Laws and Regulations Regarding Workers Who Are Non-Citizens of the United States which is included and made part of these Contract Documents.

END OF DOCUMENT 002113

DOCUMENT 004000 - BID FORM

Project Name: Lake Fort Smith and Lee Creek Fluoride Feed Systems

City Project No.: 14-10-C1

BID TO:

Owner: City of Fort Smith, Arkansas
Utility Department
3900 Kelley Highway
Fort Smith, Arkansas 72904

BID FROM:

Bidder: _____

ARTICLE 1 - BIDDER'S INTENT

1.01 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with Owner in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid price and within the Bid time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

ARTICLE 2 - TERMS AND CONDITIONS

2.01 Bidder accepts all of the terms and conditions of the Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the day of Bid opening. Bidder will sign and deliver the required number of counterparts of the Agreement with the Bonds and other documents required by the Bidding Requirements within 15 days after the date of Owner's Notice of Award.

ARTICLE 3 - BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:

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DOCUMENT 004000 - BID FORM: continued

- A. Bidder has examined and carefully studied the Bid Documents, and the following Addenda, receipt of all which is hereby acknowledged:

| <u>Number</u> | <u>Date</u> |
|---------------|-------------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

- B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, performance, and furnishing of the Work.
- C. Bidder is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, performance, and furnishing of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site; and (2) reports and drawings of a Hazardous Environmental Condition, if any, at the Site. Bidder acknowledges that such reports and drawings are not Contract Documents and may not be complete for Bidder's purposes. Bidder acknowledges that Owner and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bid Documents with respect to Underground Facilities at or contiguous to the Site.
- E. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site or otherwise which may affect cost, progress, performance, or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder and safety precautions and programs incident thereto.
- F. Bidder does not consider that any additional examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performing and furnishing of the Work in accordance with the times, price, and other terms and conditions of the Contract Documents.
- G. Bidder is aware of the general nature of Work to be performed by Owner and others at the Site that relates to Work for which this Bid is submitted as indicated in the Contract Documents.
- H. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports, and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.
- I. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Bidder.
- J. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.
- K. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm, or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced

DOCUMENT 004000 - BID FORM: continued

any person, firm, or a corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

- L. Bidder will perform the Work in compliance with all applicable trench safety standards set forth in Occupational Safety and Health Administration (OSHA) Part 1926 - Subpart P - Excavations.

ARTICLE 4 - BID PRICE

4.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

- A. LUMP SUM BID PRICE:

_____ dollars (\$_____).

- B. SUPPLIERS/MANUFACTURERS: This Bid is based upon furnishing and installing major items of Equipment by the following Suppliers/manufacturers:

| No. | Item | Supplier/Manufacturer |
|-----|---------------------|-----------------------|
| 1 | Metering Pump Skids | _____ |
| 2 | Transfer Pumps | _____ |
| 3 | Chemical Tanks | _____ |

- C. SUBCONTRACTORS: This Bid is based upon use of the following Subcontractors:

| No. | Trade | Subcontractor |
|-----|--------------------|---------------|
| 1 | Mechanical | _____ |
| 2 | Electrical | _____ |
| 3 | Systems Integrator | _____ |

ARTICLE 5 - CONTRACT TIMES

5.01 Bidder agrees that the Work will be completed within the following time(s):

- A. The Work will be Substantially Completed on or before January 30, 2016 and completed and ready for final payment in accordance with the GENERAL CONDITIONS on or before February 29, 2016.
- B. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified in the Agreement.

ARTICLE 6 - BID CONTENT

6.01 The following documents are attached to and made a condition of this Bid:

- A. Required Bid security in the form of a Bid Bond in the amount of 5% of the total Bid price.
- B. Required Bidder's Qualification Statement with supporting data.

DOCUMENT 004000 - BID FORM: continued

- C. A tabulation of Subcontractors and other persons and organizations required to be identified in this Bid.

ARTICLE 7 - COMMUNICATIONS

7.01 Communications concerning this Bid shall be addressed to the Bidder as follows:

Phone No. _____

FAX No. _____

e-mail address _____

ARTICLE 8 - TERMINOLOGY

8.01 The terms used in this Bid which are defined in the GENERAL CONDITIONS or Instructions to Bidders will have the meanings assigned to them.

SUBMITTED on _____, 2015.

State Contractor License No. _____. (If applicable)

If Bidder is :

An Individual

Name (type or printed): _____

By: _____ (SEAL)

(Individual's Signature)

Doing business as: _____

Business address: _____

Phone No.: _____ FAX No.: _____

DOCUMENT 004000 - BID FORM: continued

A Partnership

Partnership Name: _____ (SEAL)

By: _____
(Signature of general partner – attach evidence of authority to sign)

Name (type or printed): _____

Business address: _____

Phone No.: _____ FAX No.: _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability): _____

By: _____
(Signature – attach evidence of authority to sign)

Name (type or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____
(Signature of Corporate Secretary)

Business address: _____

Phone No.: _____ FAX No.: _____

END OF DOCUMENT 004000

DOCUMENT 004313 - BID BOND

KNOW ALL MEN BY THESE PRESENTS: that we

as Principal, hereinafter called the Principal, and

a corporation duly organized under the laws of the State of _____ as Surety,
hereinafter called Surety, are held and firmly bound unto

City of Fort Smith, Arkansas
3900 Kelley Highway
Fort Smith, Arkansas 72904

as Obligee, hereinafter called the Owner, in the sum of _____
_____ dollars (\$ _____), for the payment of which sum,
well and truly to be made, Principal and said Surety, bind ourselves, our heirs, executors, administrators,
successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a Bid for the Fluoride Feed Facilities. For the construction of
fluoride storage and feed facilities at the Lake Fort Smith Water Treatment Plant (WTP) near
Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas.

NOW, THEREFORE, if the Owner shall accept the Bid of Principal and the Principal shall enter into a
Contract with the Owner in accordance with the terms of such Bid, and give such Bond or Bonds as may
be specified in the Bidding or Contract Documents with good and sufficient surety for the faithful
performance of such Contract and for the prompt payment of labor and material furnished in the
prosecution thereof, or in the event of the failure of Principal to enter such Contract and give such Bond
or Bonds, if the Principal shall pay to the Owner the difference not to exceed the penalty hereof between
the amount specified in said Bid and such larger amount for which the Owner may in good faith contract
with another party to perform the Work covered by said Bid, then this obligation shall be null and void,
otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____ 2015.

PRINCIPAL

(CORPORATE SEAL)

By _____

SURETY

By _____

ATTORNEY-IN-FACT

(CORPORATE SEAL)

(This Bond shall be accompanied with
Attorney-in-Fact's authority from Surety)

END OF DOCUMENT 004313

DOCUMENT 005000 – AGREEMENT BETWEEN OWNER AND CONTRACTOR

Project Name: Lake Fort Smith and Lee Creek Fluoride Feed Systems
City Project No.: 14-10-C1

THIS AGREEMENT is dated as of the ____ day of _____ in the year 2015 by and between _____ (hereinafter called Owner) and _____ (hereinafter called Contractor).

Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1 - WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work under this Contract is generally described as follows:

Construction of fluoride storage and feed facilities at the Lake Fort Smith Water Treatment Plant (WTP) near Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas.

ARTICLE 2 - ENGINEER

2.01 The Project has been designed by Burns & McDonnell Engineering Co. Inc., who is hereinafter called Engineer and who is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE 3 - CONTRACT TIME

3.01 TIME OF THE ESSENCE:

- A. All time limits for milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

3.02 DATES FOR SUBSTANTIAL COMPLETION AND FINAL PAYMENT:

- A. The Work will be Substantially Completed on or before January 30, 2016, and completed and ready for final payment in accordance with the GENERAL CONDITIONS on or before February 29, 2016.

3.03 LIQUIDATED DAMAGES:

- A. The Contractor must agree to commence work on a date to be established, as defined in Article 2, paragraph 2.3 of the Standard General Conditions, and to complete the project within the time period specified, in consecutive calendar days, in the contract; for the Entire Work Substantial Completion on January 30, 2016 and Final Completion on February 29, 2016. The Contractor agrees to forfeit and pay, as Liquidated Damages for delay (but not as to a penalty), the amount of \$750.00 for each consecutive calendar day thereafter that expires after the

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DOCUMENT 005000 – AGREEMENT: continued

Contract Time specified above for Substantial Completion until the Work is Substantially Complete; and the amount of \$500.00 for each consecutive calendar day that expires after the time specified for Final Completion until the Work is completed and ready for Final Payment.

ARTICLE 4 - CONTRACT PRICE

4.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to paragraphs below:

- A. LUMP SUM CONTRACT PRICE: For all Work a Lump Sum of:
_____ dollars (\$_____).

ARTICLE 5 - PAYMENT PROCEDURES

5.01 SUBMITTAL AND PROCESSING OF PAYMENTS:

- A. Contractor shall submit Applications for Payment in accordance with the GENERAL CONDITIONS. Applications for Payment will be processed by Engineer as provided in the GENERAL CONDITIONS.

5.02 PROGRESS PAYMENTS, RETAINAGE:

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer, on or about the first day of each month during construction. All such payments will be measured by the schedule of values established in the GENERAL CONDITIONS or, in the event there is no schedule of values, as provided in the General Requirements.
1. Prior to 50% of Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as Engineer shall determine, or Owner may withhold, in accordance with the GENERAL CONDITIONS.
 - a. 90% of Work completed with the balance being retainage. If Engineer certifies that the Work has been 50% completed, upon such certification, the amount held by the Owner at that time shall be held for the remainder of the project and no additional retainage will be withheld from monthly progress payments.
 - b. 100% of Equipment and Materials not incorporated in the Work but delivered, suitably stored, and accompanied by documentation satisfactory to Owner as provided in the GENERAL CONDITIONS.
 2. All retainage withheld shall be paid within thirty days after the construction contract has been completed in accordance with the GENERAL CONDITIONS.

5.03 FINAL PAYMENT:

- A. Upon final completion and acceptance of the Work in accordance with the GENERAL CONDITIONS, Owner shall pay the remainder of the Contract Price as recommended by Engineer and as provided in the GENERAL CONDITIONS.

ARTICLE 6 - INTEREST

6.01 All moneys not paid when due hereunder shall bear interest at the rate in accordance with the GENERAL CONDITIONS.

ARTICLE 7 - CONTRACTOR'S REPRESENTATIONS

- 7.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents (including the Addenda) and other related data identified in the Bid Documents.
 - B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, performance, and furnishing of the Work.
 - C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, performance, and furnishing of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site; and (2) reports and drawings of a Hazardous Environmental Condition, if any, at the Site. Contractor acknowledges that Owner and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Contract Documents with respect to Underground Facilities at or contiguous to the Site.
 - E. Contractor has obtained and carefully studied (or assumes responsibility of having done so) all such additional supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site or otherwise which may affect cost, progress, performance, and furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto.
 - F. Contractor does not consider that any additional examinations, investigations, explorations, tests, studies, or data are necessary for the performing and furnishing of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.
 - G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
 - H. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.
 - I. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Contractor.
 - J. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 8 - CONTRACT DOCUMENTS

8.01 CONTENTS:

- A. The Contract Documents which comprise the entire Agreement between Owner and Contractor concerning the Work consist of the following and may only be amended, modified, or supplemented as provided in the GENERAL CONDITIONS:
 - 1. This Agreement.
 - 2. Arkansas Prevailing Wage Determination Number AR150163.
 - 3. Exhibits to this Agreement (enumerated as follows):
 - a. Notice to Proceed.
 - b. Contractor's Bid.
 - c. Documentation submitted by Contractor prior to Notice of Award.
 - 4. Performance, Payment, and other Bonds.
 - 5. General Conditions.
 - 6. Specifications consisting of divisions and sections as listed in table of contents of Project Manual.
 - 7. Drawings consisting of a cover sheet and sheets as listed in the table of contents thereof, with each sheet bearing the following general title:
 - Lee Creek & Lake Fort Smith Water Treatment Plants Fluoride Feed Systems
 - 8. The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to the GENERAL CONDITIONS.

ARTICLE 9 - MISCELLANEOUS

9.01 TERMS:

- A. Terms used in this Agreement which are defined in the GENERAL CONDITIONS shall have the meanings stated in the GENERAL CONDITIONS.

9.02 ASSIGNMENT OF CONTRACT:

- A. No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by Law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

9.03 SUCCESSORS AND ASSIGNS:

- A. Owner and Contractor each binds himself, his partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

9.04 SEVERABILITY:

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be

DOCUMENT 005000 – AGREEMENT: continued

valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

9.05 OTHER PROVISIONS:

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in triplicate. One counterpart each has been delivered to Owner, Contractor, and Engineer. All portions of the Contract Documents have been signed, initialed, or identified by Owner and Contractor or identified by Engineer on their behalf.

This Agreement will be effective on _____, 2015, which is the Effective Date of the Agreement.

CONTRACTOR _____ OWNER _____

By: _____

By: _____

Title: _____

Title: _____

(SEAL)

(SEAL)

Attest _____

Attest _____

Address for giving notices

Address for giving notices

License No. _____

(if required by Law)

(If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Agreement)

Agent for Service of process

(if required by law)

DOCUMENT 005000 – AGREEMENT: continued

(If Contractor is a corporation,
attach evidence of authority to
sign.)

Approved As to Form:

By: _____

Attorney For: _____

END OF DOCUMENT 005000

DOCUMENT 005100 - NOTICE OF AWARD

To: _____ (Bidder)

Project Name: Lake Fort Smith and Lee Creek Fluoride Feed Systems

City Project No.: 14-10-C1

Owner: City of Fort Smith, Arkansas

You are notified that your Bid, dated _____, 2015 for the above Contract has been considered. You are the apparent successful Bidder and are being awarded the Contract for the above stated Project and which is described as follows:

The construction of fluoride storage and feed facilities at the Lake Fort Smith Water Treatment Plant (WTP) near Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas.

The Contract Price of your Contract is _____ dollars (\$_____).

Three copies of the proposed Contract Documents (except Drawings) accompany this Notice of Award. Three sets of the Drawings will be delivered separately or otherwise made available to you immediately. You must comply with the following conditions precedent within 15 days of the date of this Notice of Award, that is by _____, 2015.

1. Deliver to the Owner three fully executed counterparts of the Contract Documents. Each of the counterparts must bear your signature on the Agreement Between Contractor and Owner.
2. Deliver with the executed Agreement the Contract security Bonds as specified in the Instructions to Bidders, General Conditions, and Supplementary Conditions as applicable.

Failure to comply with these conditions within the time specified will entitle Owner to consider your Bid in default, to annul this Notice of Award, and to declare your Bid security forfeited.

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterparts of the Agreement with the Contract Documents attached.

You are required to return an acknowledgement copy of this Notice of Award to the Owner.

DOCUMENT 005100 - NOTICE OF AWARD: Continued

Dated this _____ day of _____, 2015.

OWNER

By _____

Title _____

ACCEPTANCE OF AWARD

CONTRACTOR

By _____

Title _____

Date _____ 20__

Copy to Engineer
(Use Certified Mail,
Return Receipt requested)

END OF DOCUMENT 005100

DOCUMENT 005500 - NOTICE TO PROCEED

TO: _____ (Contractor)

Project Name: Lake Fort Smith and Lee Creek Fluoride Feed Systems

Contract No: 14-10-C1

Owner: City of Fort Smith, Arkansas

You are notified that the Contract Time(s) under the above Contract will commence to run on _____, 2015. By that date, you are to start performing your obligations under the Contract Documents. In accordance with the Agreement Between Owner and Contractor, the date(s) of Substantial Completion and final completion ready for final payment are January 30, 2016 and February 29, 2016, respectively.

Before you may start any work at the Site, the General Conditions provide that you and Owner must each deliver to the other, with copies to Engineer and other identified additional insureds, certificates of insurance, which each is required to purchase and maintain in accordance with the Contract Documents.

Also before you may start any work at the Site, you must submit the following:

1. Preliminary construction progress schedule.
2. Preliminary procurement schedule.
3. Preliminary schedule of Submittals.
4. Preliminary schedule of values.

You are required to return an acknowledgement copy of this Notice to Proceed to the Owner.

Dated this _____ day of _____, 2015.

OWNER

By _____
Title _____

DOCUMENT 005500 - NOTICE TO PROCEED: continued

ACCEPTANCE OF NOTICE TO PROCEED

CONTRACTOR

By _____
Title _____
Date _____, 20_____

Copy to Engineer
(Use Certified Mail,
Return Receipt Requested)

END OF DOCUMENT 005500

DOCUMENT 00 61 01 – PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that

as Principal, hereinafter called Contractor, and

as Surety, hereinafter called Surety, are held and firmly bound unto

as Obligee, hereinafter called Owner, in the amount of _____ dollars (\$_____), for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written Agreement dated _____, 2015, entered into a contract with Owner for the construction of fluoride storage and feed facilities at the Lake Fort Smith Water Treatment Plant (WTP) near Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration or extension of time made by the Owner. Whenever Contractor shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations, thereunder, the Surety may promptly remedy the default, or shall promptly:

- A. Complete the Contract in accordance with its terms and conditions, or
- B. Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, or, if the Owner elects,

DOCUMENT 00 61 01 – PERFORMANCE BOND: continued

upon determination by the Owner and the Surety jointly of the lowest responsible bidder, arrange for a contract between such bidder and Owner, and make available as Work progresses (even though there should be a default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract Price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the Contract Price," as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

Any suit under this Bond must be instituted before the expiration of two years from the date on which final payment under the Contract falls due.

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 heirs, executors, administrators, or successors of the Owner.

Signed and sealed this _____ day of _____ 2015.

CONTRACTOR

(CORPORATE SEAL)

By _____

DOCUMENT 00 61 01 – PERFORMANCE BOND: continued

SURETY COUNTERSIGNED: Resident Agent

State of Arkansas

By _____

By _____

ATTORNEY-IN-FACT

(CORPORATE SEAL)

(This Bond shall be accompanied with
Attorney-in-Fact's authority from Surety)

Approved as to Form:

Attorney for _____

END OF SECTION 00 61 01

BOND NO. _____

DOCUMENT 006119 - MAINTENANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that

as Principal, hereinafter called Contractor, and

as Surety, hereinafter called Surety, are held and firmly bound unto

The City of Fort Smith, Arkansas
3900 Kelley Highway
Fort Smith, Arkansas 72904

as Obligee, hereinafter called Owner, in the sum of _____
_____ dollars (\$_____), lawful money of the United States of

America, for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written Agreement dated _____ 2015, entered into a contract with Owner for the construction of fluoride storage and feed facilities at the Lake Fort Smith Water Treatment Plant (WTP) near Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas in accordance with the Contract Documents, which contract is by reference incorporated herein, and made a part hereof, and is referred to as the Contract.

NOW, THEREFORE, the condition of this obligation is such that, if Contractor shall remedy any defects due to faulty materials or workmanship, and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from the Date of Substantial Completion of the Work provided for in the Contract, then this obligation to be null and void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that Owner shall give Contractor and Surety notice of observed defects with reasonable promptness.

DOCUMENT 006119 - MAINTENANCE BOND: Continued

Signed and sealed this _____ day of _____ 2015.

CONTRACTOR

(CORPORATE SEAL)

By _____

SURETY

COUNTERSIGNED: Resident Agent
State of Arkansas

By _____

By _____

ATTORNEY-IN-FACT

(CORPORATE SEAL)

By _____

(This Bond shall be accompanied with
Attorney-in-Fact's authority from Surety)

Approved as to Form:

Attorney for _____

END OF DOCUMENT 006119

DOCUMENT 007200 - GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 CONTRACT DOCUMENTS:

- A. The Contract Documents establish the rights and obligations of the parties and shall consist of the following:
 - 1. The Agreement.
 - 2. Contractor's Bid (including documentation accompanying the Bid and any post-bid documentation submitted and accepted prior to Notice of Award) when attached as an exhibit to the Agreement.
 - 3. Arkansas Prevailing Wage Determination Number AR150163.
 - 4. Notice to Proceed.
 - 5. Bonds.
 - 6. General Conditions.
 - 7. Specifications.
 - 8. Contract Drawings.
 - 9. Addenda relating to any of the Contract Documents.
 - 10. Modifications issued on or after the Effective Date of Agreement including Written Amendments, Change Orders, Work Change Directives, Field Orders, and Engineer's written interpretations and clarifications.
 - 11. Construction Phase Storm Water Pollution Prevention Plan.
- B. Reports and drawings of subsurface and physical conditions and approved Submittals by Contractor are not Contract Documents.

1.02 DEFINITIONS:

- A. Wherever used in these General Conditions or elsewhere in the Contract Documents, the following terms have the meanings indicated below, which are applicable to both the singular and plural thereof:
 - 1. "Addenda" - written or graphic changes or interpretations of the Contract Documents issued by Engineer prior to the opening of Bids.
 - 2. "Agreement" - the written agreement between Owner and Contractor covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.
 - 3. "Application for Payment" - the form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress and final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 - 4. "Asbestos" - any material that contains more than 1% asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 - 5. "Bid" - the formal offer of the Bidder submitted on the prescribed Bid Form together with the required Bid security and all information submitted with the Bid that pertains to performance of the Work.
 - 6. "Bidder" - any person, firm, or corporation submitting a Bid for the Work or their duly authorized representatives.
 - 7. "Change Order" - a written document signed by Owner and Engineer authorizing an addition, deletion, or revision in the Work, or an adjustment in the Contract Price or the Contract Time issued on or after execution of the Agreement.

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DOCUMENT 007200 - GENERAL CONDITIONS: continued

8. "Contract Drawings" - drawings and other data designated as Contract Drawings prepared by Engineer for this Contract which show the character and scope of the Work to be performed and are referred to in the Contract Documents.
9. "Contract Price" - the total monies payable to Contractor under the Contract Documents as stated in the Agreement.
10. "Contract Times" - the number of days or the dates stated in the Agreement to: (i) achieve Substantial Completion; and (ii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
11. "Contractor" - the person, firm or corporation with whom Owner has entered into the Agreement.
12. "Date of Contract", "Effective Date of the Agreement" - the date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
13. "Day" - a calendar day of 24 hours measured from midnight to the next midnight shall constitute a day.
14. "Engineer" or "Engineer-Architect" - Burns & McDonnell Engineering Company, a Missouri Corporation, or its duly authorized representatives.
15. "Engineer's Consultant" - an individual or entity having a contract with Engineer to furnish services as Engineer's independent professional associate or consultant with respect to the Project.
16. "Equipment" - a product with operational or nonoperational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.
17. "Field Order" - a written order issued by Engineer which orders minor changes in the Work in accordance with Paragraph 9.05 but which does not involve a change in the Contract Price or the Contract Times.
18. "General Requirements" - Sections of DIVISION 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.
19. "Hazardous Waste" - the term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
20. "Law" - law of the place of the Project which shall govern the performance hereunder.
21. "Laws and Regulations," "Laws or Regulations" - laws, rules, regulations, ordinances, codes and/or orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
22. "Lien" - charges, security interests, or encumbrances on Project funds, real property, or personal property.
23. "Materials" - products substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form a part of the Work.
24. "Notice of Award" - the written notice by Owner to the apparent successful Bidder stating that upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, Owner will sign and deliver the Agreement.
25. "Notice to Proceed" - the written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform Contractor's obligation under the Contract Documents.
26. "Owner" - the public body or authority, corporation, association, partnership, or individual with whom the Contractor has entered into the Agreement and for whom the Work is to be provided.

DOCUMENT 007200 - GENERAL CONDITIONS: continued

27. "Partial Utilization" - placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion of all the Work.
28. "PCBs" - Polychlorinated biphenyls.
29. "Petroleum" - petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60°Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.
30. "Project" - the total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.
31. "Project Manual" - The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
32. "Radioactive Material" - source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
33. "Resident Project Representative" - the authorized representative of Engineer who is assigned to the construction Site or any part thereof.
34. "Reference Drawings" - drawings not specifically prepared for this Contract, but which contain information pertinent to the Work.
35. "Samples" - physical examples of Equipment, Materials, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
36. "Shop Drawings" - all drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
37. "Site" - lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
38. "Specifications" - those portions of the Contract Documents consisting of written technical descriptions of the Work, and covering the Equipment, Materials, workmanship, and certain administrative details applicable thereto.
39. "Subcontractor" - an individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
40. "Submittals" - all Shop Drawings, product data, and Samples which are prepared by Contractor, a Subcontractor, manufacturer, or Supplier, and submitted by Contractor to Engineer as a basis for approval of the use of Equipment and Materials proposed for incorporation in the Work or needed to describe proper installation, operation and maintenance, or technical properties.
41. "Substantial Completion" - the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer as evidenced by his definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be used for the purposes for which it was intended.
42. "Supplier" - a manufacturer, fabricator, supplier, distributor, materialman, or vendor.

DOCUMENT 007200 - GENERAL CONDITIONS: continued

43. "Underground Facilities" - all pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, or water.
44. "Unit Price Work" - Work to be paid on the basis of Unit Prices.
45. "Work" - the entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, the furnishing of Bonds and insurance, furnishing labor, and furnishing and incorporating Materials and Equipment into the construction, all as required by the Contract Documents.
46. "Work Change Directive" - a written directive to Contractor, issued on or after the effective Date of the Agreement and signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in Article 4 or to emergencies under Paragraph 6.13. A Work Change Directive may not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times as provided in Paragraph 10.01B.
47. "Written Amendment" - a written amendment to the Contract Documents, signed by Owner and Contractor on or after the Effective Date of the Agreement, and normally dealing with the nonengineering or nontechnical rather than strictly Work-related aspects of the Contract Documents.
48. "electronic equipment compliance" or "electronically compliant" – means that equipment, devices, items, systems, software, hardware, and firmware included in the Work or used to produce the Work shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing).

1.03 TERMINOLOGY:

- A. Whenever used in these General Conditions or elsewhere in the Contract Documents, the following terminology shall have the intent and meaning specified below:
 1. The words "as indicated" refer to the Drawings and "as specified" refer to the remaining Contract Documents.
 2. The terms "responsible" or "responsibility" mean that the party to which the term applies shall assume all responsibilities thereto.
 3. The term "approve", when used in response to Submittals, requests, applications, inquiries, reports and claims by Contractor, will be held to limitations of Engineer's responsibilities and duties or specified in these General Conditions. In no case will "approval" by Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of Contract Documents.
 4. When applied to Equipment and Materials, the words "furnish", "install", and "provide" shall mean the following:
 - a. The word "provide" shall mean to furnish, pay for, deliver, assemble, install, adjust, clean and otherwise make Materials and Equipment fit for their intended use.
 - b. The word "furnish" shall mean to secure, pay for, deliver to Site, unload and uncrate Equipment and Materials.

DOCUMENT 007200 - GENERAL CONDITIONS: continued

- c. The word "install" shall mean to assemble, place in position, incorporate in the Work, adjust, clean, and make fit for use.
- d. The phrase "furnish and install" shall be equivalent to the word "provide."

ARTICLE 2 - PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS:

- A. When Contractor delivers the executed Agreements to Owner, Contractor shall also deliver to Owner such Bonds as Contractor may be required to furnish in accordance with Paragraph 5.01.

2.02 COPIES OF DOCUMENTS:

- A. Owner will furnish to Contractor copies of the Contract Documents as stated in the General Requirements.

2.03 COMMENCEMENT OF CONTRACT TIMES; NOTICE TO PROCEED:

- A. The Contract Times will commence to run on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the 75th day after the day of Bid opening or the 30th day after the Effective Date of the Agreement, whichever date is earlier.

2.04 STARTING THE PROJECT:

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 BEFORE STARTING CONSTRUCTION:

- A. Before starting construction and undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby; however, Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, or discrepancy in the Contract Documents, unless Contractor had actual knowledge thereof or should reasonably have known thereof.
- B. Within ten days after the Effective Date of the Agreement unless otherwise specified in the General Requirements, Contractor shall submit to Engineer for review:
 - 1. An estimated construction progress schedule indicating the starting and completion dates of the various stages of the Work.
 - 2. A preliminary procurement schedule.
 - 3. A preliminary schedule of Submittal submissions.
 - 4. A preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work which will be confirmed in writing by Contractor at the time of submission.

DOCUMENT 007200 - GENERAL CONDITIONS: continued

- C. Before any Work at the Site is started, Contractor shall deliver to Owner, with a copy to Engineer, certificates and other evidence of insurance requested by Owner which Contractor is required to purchase and maintain in accordance with Paragraph 5.02 and Owner shall deliver to Contractor certificates and other evidence of insurance requested by Contractor which Owner is required to purchase and maintain in accordance with Paragraph 5.02.

2.06 PRECONSTRUCTION CONFERENCE:

- A. Within 20 days after the Effective Date of the Agreement, but before Contractor starts the Work at the Site, a conference attended by Contractor, Engineer, and others as appropriate will be held to discuss the schedules referred to in Paragraph 2.05B to discuss procedures for handling Submittals, processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

2.07 FINALIZING SCHEDULES:

- A. At least ten days before submission of the first Application for Payment, a conference attended by Contractor, Engineer, and others as appropriate will be held to finalize the schedules submitted in accordance with Paragraph 2.05B. The finalized construction progress schedule will be acceptable to Engineer as providing an orderly progression of the Work to completion within the Contract Times, but such acceptance will neither impose on Engineer responsibility for the progress or scheduling of the Work nor relieve Contractor from full responsibility therefor. The finalized schedule of Submittal submissions will be acceptable to Engineer as providing a workable arrangement for processing the submissions. The finalized schedule of values will be acceptable to Engineer as to form and substance.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 INTENT:

- A. The Contract Documents comprise the entire agreement between Owner and Contractor concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the Law of the place of the Project.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, Materials, or Equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result will be supplied whether or not specifically called for.
 - 1. When words which have a well-known technical or trade meaning are used to describe Work, Materials, or Equipment, such words shall be interpreted in accordance with that meaning.
 - 2. Reference to standard specifications, manuals, or codes of any technical society, organization, or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of Owner, Contractor, or Engineer, or any of their consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Engineer, or any of Engineer's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or

DOCUMENT 007200 - GENERAL CONDITIONS: continued

any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.10C or 9.10D.

3. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Paragraph 9.04.
- C. If, during the performance of the Work, Contractor finds a conflict, error, or discrepancy in the Contract Documents, Contractor shall so report to Engineer in writing at once and before proceeding with the Work affected thereby shall obtain a written interpretation or clarification from Engineer; however, Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof or should reasonably have known thereof.
- D. In case of any conflict between manufacturers' data and the Contract Documents, the Contract Documents will take precedence unless the manufacturers' data conforms to data submitted with the Bid with a statement that the Bid is conditioned upon furnishing the Equipment and Materials defined in the manufacturers' data submitted therewith.
- E. Applicable codes and standards referenced in these Contract Documents establish minimum requirements for Equipment, Materials, and Work and are superseded by more stringent requirements of Contract Documents when and where they occur.
- F. The Specifications are separated into Divisions and Sections for convenience in defining the Work. Contract Drawings are separated according to engineering disciplines and other classifications. This sectionalizing and the arrangement of Contract Drawings shall not control the Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

3.02 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS:

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:
 1. A formal Written Amendment.
 2. A Change Order pursuant to Paragraph 10.01D.
- B. As indicated in Paragraphs 11.01B and 12.01A, Contract Price and Contract Times may only be changed by a Change Order or Written Amendment.
- C. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in the following way:
 1. A Field Order pursuant to Paragraph 9.05.
 2. Engineer's written interpretation or clarification pursuant to Paragraph 9.04.

3.03 OWNERSHIP AND REUSE OF DOCUMENTS:

- A. All Contract Documents and copies thereof furnished by Engineer shall remain his property. With the exception of those copies signed in connection with the execution of the Agreement, all Contract Documents shall be returned to Engineer on request upon completion of the Work.
- B. Neither Contractor nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with Owner shall have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents or copies of any thereof prepared by or bearing the seal of Engineer; and they shall not reuse any of the documents on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

ARTICLE 4 - AVAILABILITY OF LANDS; PHYSICAL CONDITIONS; REFERENCE POINTS

4.01 AVAILABILITY OF LANDS:

- A. Owner shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of Contractor. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by Owner, unless otherwise provided in the Contract Documents.
- B. If Contractor believes that any delay in Owner's furnishing these lands, rights-of-way, or easements entitles Contractor to an extension of the Contract Times, Contractor may make a claim therefor as provided in Article 12.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of Materials and Equipment.
- D. Contractor shall confine his operations to the construction limits indicated.

4.02 UNFORESEEN SUBSURFACE CONDITIONS:

- A. Contractor shall promptly notify Engineer in writing of any subsurface or latent physical conditions encountered at the Site which differ materially from those specified or indicated, or which could be reasonably interpreted from examination of the Site and available subsurface information at the time of bidding.
- B. Engineer will promptly investigate those conditions and advise Owner if further surveys or subsurface tests are necessary. Promptly thereafter, Owner will obtain the necessary additional surveys and tests and furnish copies of results to Engineer and Contractor.
- C. If Engineer finds that the subsurface or latent physical conditions encountered at the Site differ materially from those specified or indicated, or which could have been reasonably interpreted from examination of the Site and available subsurface information at the time of bidding, then a Change Order will be issued incorporating the necessary revisions.

4.03 PHYSICAL CONDITIONS - UNDERGROUND FACILITIES:

- A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided:
 - 1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and,
 - 2. Contractor shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction, for the safety and protection thereof as provided in Paragraph 6.12 and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.
- B. Not Shown or Indicated: If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated in the Contract Documents and which Contractor could not reasonably have been expected to be aware of, Contractor shall, promptly after becoming aware thereof and before performing any Work affected thereby except in an emergency as permitted by Paragraph 6.13, identify the owner of such Underground Facility and give written notice thereof to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of

the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility as provided in Paragraph 6.12. Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and which Contractor could not reasonably have been expected to be aware of. If the parties are unable to agree as to the amount or length thereof, Contractor may make a claim therefor as provided in Articles 11 and 12.

4.04 REFERENCE POINTS:

- A. Owner will provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work (unless otherwise specified in the General Requirements), shall protect and preserve the established reference points, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel. Contractor shall be responsible for any mistakes or loss of time that may result from their loss or disturbance.
- B. Contractor shall make such surveys as are required for establishing pay limits and determining quantities for progress pay estimates. He shall furnish Engineer with one copy of all field notes of such surveys.

4.05 ASBESTOS, PCBS, PETROLEUM, HAZARDOUS WASTE, OR RADIOACTIVE MATERIAL:

- A. Owner shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the Site. Owner shall not be responsible for any such materials brought to the Site by Contractor, Subcontractor, Suppliers, or anyone else for whom Contractor is responsible.
- B. Contractor shall immediately: (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by Paragraph 6.13), and (ii) notify Owner and Engineer (and thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such hazardous condition or take corrective action, if any. Contractor shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after Owner has obtained any required permits related thereto and delivered to Contractor special written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by Contractor to be resumed, either party may make a claim therefor as provided in Articles 11 and 12.
- C. If after receipt of such special written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order such portion of the Work that is in connection with

DOCUMENT 007200 - GENERAL CONDITIONS: continued

such hazardous condition or in such affected area to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefor as provided in Articles 11 and 12. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

- D. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, Engineer, Engineer's Consultants, and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages arising out of or resulting from such hazardous condition, provided that: (i) any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) nothing in this subparagraph 4.05D shall obligate Owner to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.
- E. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, Engineer, Engineer's Consultants, and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages arising out of or relating to such hazardous condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this subparagraph 4.05E shall obligate Contractor to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.
- F. The provisions of Paragraphs 4.02 and 4.03 are not intended to apply to Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS:

- A. Contractor shall furnish Arkansas Performance and Payment, and Maintenance Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all Contractor's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as otherwise provided by Law or Regulation or by the Contract Documents. Contractor shall also furnish such other Bonds as are required by the Contract Documents. All Bonds shall be in the forms prescribed by Law or Regulation or by the Contract Documents and be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury.
- B. The Bonds shall be automatically increased in amount and extended in time without formal and separate amendments to cover full and faithful performance of the Contract in the event of Change Orders, regardless of the amount of time or money involved. It is Contractor's responsibility to notify his surety of any changes affecting the general scope of the Work or change in the Contract Price or Contract Times.
- C. Bonds signed by an agent must be accompanied by a certified copy of the authority to act.
- D. Date of Bonds shall be the same as the Effective Date of the Agreement.
- E. If at any time during the continuance of the Contract, the surety on any Bond becomes unacceptable to Owner for financial reasons, Owner has the right to require additional and

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sufficient sureties which Contractor shall furnish to the satisfaction of Owner within ten days after notice to do so.

- F. If the surety on any Bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01A, Contractor shall within five days thereafter substitute another Bond and surety, both of which must be acceptable to Owner.
- G. Bond Requirements:
1. The Contractor to whom the Work is awarded shall be required to furnish the following Surety Bonds:
 - a. Arkansas Performance and Payment Bond: The successful Bidder shall furnish the supplied Arkansas Performance and Payment Bond in an amount equal to one hundred percent (100%) of the awarded Contract. After execution of the Contract and prior to the start of Work, said Bond shall be filed by the Contractor with the Circuit Court of the county where the Work is to be performed and two "file" stamped copies shall be provided to Owner. When filed, no Lien shall attach thereunder and any Liens which may have already been filed shall be discharged.
 - b. Maintenance Bond: A Bond to the Owner for a period of one year from and immediately following the date on which final payment under the Contract falls due and the acceptance thereof by said Owner, in the amount of five percent (5%) of the Contract.
 - (1) For and during a period of one year from and immediately following the date on which final payment under the Contract falls due and the acceptance thereof by said Owner, the said Contractor shall pay, or cause to be paid, to said Owner, all damages, loss, and expenses which may occur to the said Owner, by reason of defective materials used, or by reason of defective workmanship done, for, and the construction of, the said Work.
 - (2) If any items covered by the Maintenance Bond are not repaired or replaced by the Contractor within a reasonable time, as determined by the Owner, or if a hazard occurs as a result of disrepairs, the Owner shall have the right to correct, or have corrected such disrepair, at the expense of the Contractor or Bonding Company.
 2. All Bonds shall be executed to the forms hereto attached, signed by a surety company authorized to do business in the State of Arkansas, require the appointment and signature of Arkansas Agent, and acceptable as surety to the Owner. Each Bond shall be accompanied by a "Power of Attorney."

5.02 INSURANCE:

- A. Contractor's Liability Insurance:
1. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being furnished and performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's furnishing and performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - a. Claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - b. Claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

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- c. Claims for damages because of bodily injury, sickness, or disease, or death of any person other than Contractor's employees;
 - d. Claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or (ii) by any other person for any other reason;
 - e. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use therefrom;
 - f. Claims arising out of operation of Laws or Regulations for damages because of bodily injury or death of any person or for damage to property; and
 - g. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle.
2. The insurance required by this paragraph shall include the specific coverages, and be written for not less than the limits of liability specified or required by Law, whichever is greater.
- a. Workers' compensation: Statutory
 - b. Employer's Liability: Each accident
\$ 500,000
 - c. Commercial General Liability:
 - Bodily Injury (including completed operations and products liability)
 - \$ 1,000,000 Each occurrence
 - \$ 2,000,000 Annual aggregate
 - Property Damage
 - \$ 1,000,000 Each occurrence
 - \$ 2,000,000 Annual aggregate
 - or a combined single limit of \$ 2,000,000
 - d. Commercial Automobile Liability:
 - Bodily Injury
 - \$ 1,000,000 Each person
 - \$ 1,000,000 Each occurrence
 - Property Damage
 - \$ 1,000,000 Each occurrence
 - or a combined single limit of \$ 1,000,000
 - e. Umbrella Liability Insurance: This insurance shall be written to extend the effective limits for employer's liability, commercial general liability, and commercial automobile liability and shall include additional insureds as specified in 5.02B and be written for \$10,000,000 per occurrence and project annual aggregate.
- B. The policies of insurance so required by paragraph 5.02A to be purchased and maintained shall:
- 1. with respect to insurance required by paragraphs 5.02A.1.c through 502A.1.g inclusive, include as additional insureds by endorsement (subject to customary exclusion in respect of professional liability) Owner, Engineer, and Engineer's Consultants, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

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2. include at least the specific coverages and be written for not less than the limits of liability specified in paragraph 5.02A.2 or required by Laws and Regulations, whichever is greater;
 3. include completed operations insurance and premises/operations insurance;
 4. include in the commercial general liability policy, contractual liability insurance covering Contractor's indemnity obligations under paragraphs 6.06, 6.10, and 6.16, and written for not less than the limits of liability and coverages specified:
Bodily Injury
\$ 1,000,000 Each occurrence
Property Damage
\$ 1,000,000 Each occurrence
\$ 2,000,000 Annual aggregate
 5. contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed, or renewal refused until at least 30 days' prior written notice by certified mail has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued ;
 6. provide Broad Form Property Damage coverage and contain no exclusion (commonly referred to as XC&U exclusion) relative to blasting, explosion, collapse of buildings, or damage to underground property;
 7. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07;
 8. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and Contractor shall furnish Owner and each other specified additional insured to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter); and
 9. include Independent Contractors Protective Liability coverage.
- C. Owner's Protective Liability Insurance:
1. Contractor shall be responsible for purchasing and maintaining Owner's Protective Liability insurance with Owner and Engineer as named insureds.
 2. This insurance shall have the same limits of liability as the Commercial General Liability insurance and shall protect Owner and Engineer against any and all claims and liabilities for injury to or death of persons, or damage to property caused in whole or in part by, or alleged to have been caused in whole or in part by, negligent acts or omissions of Contractor or Subcontractors or any agent, servant, worker, or employee of Contractor or Subcontractors arising from the operations under the Contract Documents.
 3. This insurance may be provided by endorsement to Contractor's Commercial General Liability insurance policy.
- D. Property Insurance:
1. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full insurable value thereof or as required by Laws or Regulations. This insurance shall:
 - a. be on the completed value form and include the interests of Owner, Contractor, Subcontractors, Engineer, and Engineer's Consultants, and the officers, directors, partners, employees, agent, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an additional insured;

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- b. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and Equipment and Materials, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils or causes of loss as may be specifically required in the Contract Documents;
 - c. include expenses incurred in the repair or replacement of any insured property including but not limited to fees and charges of engineers, architects, attorneys, and other professionals;
 - d. cover Equipment and Materials stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such Equipment and Materials have been included in an Application for Payment recommended by Engineer;
 - e. allow for partial utilization of the Work by Owner;
 - f. include testing and startup;
 - g. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days' written notice to each other additional insured to whom a certificate of insurance has been issued; and
2. Contractor shall purchase and maintain such boiler and machinery insurance or additional property insurance as required by Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, Engineer, and Engineer's Consultants in the Work, each of whom is deemed to have an insurable interest and shall be listed as insured or additional insured parties.
 3. All policies of insurance required to be purchased and maintained in accordance with Paragraph 5.02D will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least 30 days' prior notice by certified mail has been given to Owner and Contractor and to each additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.02F below.
 4. Copies of the policies shall be furnished for property insurance. Certificates will not be acceptable.
- E. Transit Insurance:
1. Transit insurance shall be furnished by Contractor to protect Contractor and Owner from all risks of physical loss or damage to Equipment and Materials, not otherwise covered under other policies, during transit from point of origin to the Site of installation or erection.
 2. This insurance shall be written on an "All Risk" basis with additional coverages applicable to the circumstances that may occur in the particular Work included in this Contract.
 3. This insurance shall be in an amount not less than 100% of the manufactured or fabricated value of items exposed to risk in transit at any one time.
 4. This insurance shall contain a waiver of rights of subrogation the insurer may have or acquire against Engineer.
- F. Waiver of Rights:
1. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.02D will protect Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants, and other individuals or entities endorsed as insureds or additional insureds (and the

officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage, the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder; and if the insurers require separate waiver forms to be signed by Engineer or Engineer's Consultants, Owner will obtain the same, and if such waiver forms are required of any Subcontractor, Contractor shall obtain the same.

2. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies required by Paragraph 5.02D and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, Engineer, Engineer's Consultants, and all other individuals or entities endorsed as insureds or additional insureds and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them under such policies for losses and damages so caused. As required by Paragraph 6.05D, each subcontract between Contractor and a Subcontractor shall contain similar waiver provisions by the Subcontractor in favor of Owner, Contractor, Engineer, Engineer's Consultants, and all other parties endorsed as insureds or additional insureds. None of the above waivers shall extend to the rights that any of the insured parties may have to proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.
- G. Receipt and Application of Insurance Proceeds:
1. Any insured loss under the policies of insurance required by Paragraph 5.02D will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.02G.2. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied to account thereof, and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.
 2. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection is made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties upon the occurrence of an insured loss.
- H. Acceptance of Insurance:
1. If Owner has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by Contractor in accordance with Paragraph 5.02 on the basis of non-conformance with the Contract Documents, Owner shall so notify Contractor in writing thereof within 10 days of the date of delivery of such certificates and other evidence of insurance to Owner required by Paragraph 2.05C.
 2. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the insurance required of such party by the Contract

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Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

- I. Partial Utilization, Acknowledgment of Property Insurer:
 - 1. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.06, no such use or occupancy shall commence before the insurers providing property insurance pursuant to Paragraph 5.02D have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE:

- A. Contractor shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work, but Contractor shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence, or procedure of construction which is indicated in and required by the Contract Documents. Contractor shall be responsible to see that the finished Work complies accurately with the Contract Documents.
- B. Contractor shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to the superintendent shall be as binding as if given to Contractor.
- C. When manufacturer's field services in connection with the erection, installation, start-up, or testing of Equipment furnished under this Contract, or instruction of Owner's personnel thereon are specified, Contractor shall keep on the Work, during its progress or as specified, competent manufacturer's field representatives and any necessary assistants.

6.02 LABOR, EQUIPMENT, AND MATERIALS:

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site. Except in connection with the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the Site shall be performed during regular working hours, and Contractor will not permit overtime work or the performance of Work on Saturday, Sunday, or any legal holiday without Owner's written consent given after prior written notice to Engineer.
- B. Unless otherwise specified in the General Requirements, Contractor shall furnish and assume full responsibility for all Equipment and Materials, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary

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- facilities, temporary facilities, and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up, and completion of the Work.
- C. All Equipment and Materials shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of Equipment and Materials. All Equipment and Materials shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the instructions of the applicable Supplier except as otherwise provided in the Contract Documents; but no provision of any such instructions will be effective to assign to Engineer, or any of Engineer's consultants, agents, or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.10C and 9.10D.
 - D. All Equipment and Materials incorporated in the Work shall be designed to meet the applicable safety standards of federal, state, and local Laws and Regulations.
 - E. Electronic Equipment Compliance:
 - 1. Contractor warrants that all equipment, devices, items, systems, software, hardware or firmware provided under this Contract shall be electronically compliant, meaning that they shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supercedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

6.03 ADJUSTING PROGRESS SCHEDULE:

- A. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) adjustments in the progress schedule to reflect the impact thereon of new developments; these will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

6.04 SUBSTITUTES OR "OR-EQUAL" ITEMS:

- A. Whenever an item of Equipment or Material is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitute is permitted, other items of Equipment or Material of other Suppliers may be submitted by Contractor to Engineer for review under the circumstances described below.
 - 1. "Or-Equal" Items: If in Engineer's sole discretion an item of Equipment or Material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For purposes of this Paragraph 6.04A.1, a proposed item of Equipment or Material will be considered functionally equal to an item so named if:
 - a. In the exercise of reasonable judgment Engineer determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it

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- will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;
- b. Contractor certifies that: (i) there is no increase in cost to Owner; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.
2. Substitute Items:
- a. If in Engineer's sole discretion an item of Equipment or Material proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.04A.1, it will be considered a proposed substitute item.
 - b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of Equipment or Material proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of Equipment or Materials will not be accepted by Engineer from anyone other than Contractor.
 - c. The procedure for review by Engineer will be as set forth in paragraph 6.04A.2.d, as may be supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.
 - d. Contractor shall first make written application to Engineer for review of a proposed substitute item of Equipment or Material that Contractor seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute will prejudice Contractor's achievement of Substantial Completion on time; whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for work on the Project) to adapt the design to the proposed substitute item; and whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by Engineer in evaluating the proposed substitute item. Engineer may require Contractor to furnish additional data about the proposed substitute item.
- B. If a specific means, method, technique, sequence, or procedure of construction is indicated in or required by the Contract Documents, Contractor may furnish or use a substitute means, method, sequence, technique, or procedure of construction acceptable to Engineer, if Contractor submits sufficient information to allow Engineer to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedure for review by Engineer will be similar to that provided in Paragraphs 6.04A.2 as applied by Engineer and as may be supplemented in the General Requirements.
- C. Engineer will be allowed a reasonable time within which to evaluate each proposed substitute or "or-equal" item. Engineer will be the sole judge of acceptability, and no substitute or "or-equal" will be ordered, installed, or used until Engineer's review is complete, which will be evidenced by either (i) a Change Order for a substitute, or (ii) an approved Submittal for an

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"or-equal." Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

- D. Engineer will record time required by Engineer and Engineer's Consultants in evaluating substitute proposed or submitted by Contractor pursuant to Paragraphs 6.04A.2 and 6.04B and in making changes in the Contract Documents (or in the provisions of any other direct contract with Owner for work on the Project) occasioned thereby. Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer and Engineer's Consultants for evaluating each such proposed substitute.

6.05 CONCERNING SUBCONTRACTORS, SUPPLIERS, AND OTHERS:

- A. Contractor shall not employ any Subcontractor, Supplier, or other person or organization (including those acceptable to Owner and Engineer as indicated in Paragraph 6.05B), whether initially or as a substitute, against whom Owner or Engineer may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other person or organization to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Contract Documents require the identity of certain Subcontractors, Suppliers, or other persons or organizations (including those who are to furnish the principal items of Equipment and Materials) to be submitted to Owner within the required time after Bid opening prior to the Effective Date of the Agreement for acceptance by Owner and Engineer and if Contractor has submitted a list thereof, Owner's or Engineer's acceptance (either in writing or by failing to make written objection thereto) of any such Subcontractor, Supplier, or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case Contractor shall submit an acceptable substitute, the Contract Price will be increased by the difference in the cost occasioned by such substitution, and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by Owner or Engineer of any such Subcontractor, Supplier, or other person or organization shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents shall create any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other person or organization, nor shall it create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other person or organization except as may otherwise be required by Laws and Regulations.
- D. All Work performed for Contractor by a Subcontractor will be pursuant to an appropriate agreement between Contractor and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer and contains waiver provisions as required by Paragraph 5.02F. Contractor shall pay each Subcontractor a just share of any insurance moneys received by Contractor on account of losses under policies issued pursuant to Paragraph 5.02D.

6.06 PATENT FEES AND ROYALTIES:

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents

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for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

- B. Contractor shall indemnify and hold harmless Owner and Engineer and anyone directly or indirectly employed by either of them from and against all claims, damages, losses, and expenses (including attorneys' fees and court and arbitration costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

6.07 PERMITS:

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids. Contractor shall pay all charges of utility owners for connections to the Work, and Owner shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

6.08 LAWS AND REGULATIONS:

- A. Contractor shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor observes that the Specifications or Drawings are at variance with any Laws or Regulations, Contractor shall give Engineer prompt written notice thereof, and any necessary changes will be authorized by one of the methods indicated in Paragraph 3.02. If Contractor performs any Work knowing or having reason to know that it is contrary to such Laws or Regulations, and without such notice to Engineer, Contractor shall bear all costs arising therefrom; however, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and Regulations.

6.09 TAXES:

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid or withheld by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.10 USE OF PREMISES:

- A. Contractor shall confine construction equipment, the storage of Equipment and Materials, and the operations of workers to the Project Site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits, and easements, and shall not unreasonably encumber the premises with construction equipment or other equipment and materials. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against Owner or Engineer by any such owner or occupant because of the performance of the Work, Contractor shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at Law. Contractor shall, to the

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- fullest extent permitted by Laws and Regulations, indemnify and hold Owner and Engineer harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals, and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any such other party against Owner or Engineer to the extent based on a claim arising out of Contractor's performance of the Work.
- B. During the progress of the Work, Contractor shall keep the premises free from accumulations of waste materials, rubbish, and other debris resulting from the Work. At the completion of the Work, Contractor shall remove all waste materials, rubbish, and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the Site clean and ready for occupancy by Owner. Contractor shall restore to original condition all property not designated for alteration by the Contract Documents.
 - C. Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.11 RECORD DOCUMENTS:

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Test Records, Field Orders, and written interpretations and clarifications (issued pursuant to Paragraph 9.04) in good order and annotated to show all changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Submittals shall be available to Engineer for reference. Upon completion of the Work, these record documents and Submittals shall be delivered to Engineer for Owner.
- B. Receipt and acceptance of record documents will be a prerequisite for final payment on the Contract.

6.12 SAFETY AND PROTECTION:

- A. Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. All employees on the Work and other persons and organizations who may be affected thereby;
 - 2. All the Work and Materials and Equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. Other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All damage, injury or loss to any property referred to in Paragraph 6.12A.2 or 6.12A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the

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Work or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor). Contractor's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.09A that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

- C. Contractor shall designate a responsible representative at the Site whose duty shall be the prevention of accidents. This person shall be Contractor's superintendent unless otherwise designated in writing by Contractor to Owner.

6.13 EMERGENCIES:

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor, without special instruction or authorization from Engineer or Owner, is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If Engineer determines that a change in the Contract Documents is required because of the action taken in response to an emergency, a Change Order will be issued to document the consequences of the changes or variations.

6.14 SUBMITTALS:

- A. After checking and verifying all field measurements and after complying with applicable procedures specified in the General Requirements, Contractor shall submit to Engineer for review and acceptance in accordance with the accepted schedule of submissions, copies of Submittals which will bear the required information that Contractor has satisfied Contractor's responsibilities under the Contract Documents with respect to the review of the submission. All submissions will be identified as Engineer may require. The data shown on Submittals will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to enable Engineer to review the information as required.
- B. Before submission of each Submittal, Contractor shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and reviewed or coordinated each Submittal with other Submittals and with the requirements of the Work and the Contract Documents.
- C. At the time of each submission, Contractor shall give Engineer specific written notice of each variation that the Submittal may have from the requirements of the Contract Documents, and in addition, shall cause a specific notation to be made on each Submittal submitted to Engineer for review and approval of each such variation.
- D. Engineer will review Submittals with reasonable promptness, but Engineer's review and acceptance will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences, or procedures of construction (except where a specific means, method, technique, sequence, or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the

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- item functions. Contractor shall make corrections required by Engineer, and shall return the required number of corrected copies of Submittals and resubmit as required for review and acceptance. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
- E. Engineer will record all labor and expenses required to review submittals that are submitted four or more times prior to final acceptance. Contractor shall reimburse Owner for all labor and expense required for review of fourth and all subsequent submittals.
 - F. Engineer's review and acceptance of Submittals shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents. Contractor shall in writing call Engineer's attention to each and every variation at the time of submission. Engineer will show approval of each such variation by a specific written notation thereof incorporated in or accompanying the Submittal. Acceptance by Engineer shall not relieve Contractor from responsibility for errors or omissions in the Submittals.
 - G. Where a Submittal is required by the Specifications, any related Work performed prior to Engineer's review and acceptance of the pertinent submission will be the sole expense and responsibility of Contractor.

6.15 CONTINUING THE WORK:

- A. Contractor shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.03 or as Contractor and Owner may otherwise agree in writing.

6.16 INDEMNIFICATION:

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, Engineer, Engineer's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them from and against all claims, damages, losses and expenses, direct, indirect, or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and court and arbitration costs) arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss, or expense:
 - 1. Is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (including the Work itself) including the loss of use resulting therefrom, and
 - 2. Is caused in whole or in part by any negligent act or omission of Contractor, any Subcontractor, any person, or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder or arises by or is imposed by Laws and Regulations regardless of the negligence of any such party.
- B. In any and all claims against Owner or Engineer or any of their consultants, agents, or employees by any employee of Contractor, any Subcontractor, any person, or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.16A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor or other person or organization under workers' or workmen's compensation acts, disability benefit acts, or other employee benefit acts.

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- C. The obligations of Contractor under 6.16A shall not extend to the liability of Engineer, Engineer's consultants, agents, or employees arising out of:
 - 1. The preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or specifications.
 - 2. The giving of or the failure to give communications by Engineer, its agents, or employees provided such giving or failure to give is the primary cause of injury or damage.

ARTICLE 7 - OTHER WORK

7.01 RELATED WORK AT SITE:

- A. Owner may perform other work related to the Project at the Site by Owner's own forces, have other work performed by utility owners, or let other direct contracts therefor which shall contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to Contractor prior to starting any such other work; and, if Contractor believes that such performance will involve additional expense to Contractor or requires additional time and the parties are unable to agree as to the extent thereof, Contractor may make a claim therefor as provided in Articles 11 and 12.
- B. Contractor shall afford each utility owner and other contractor who is a party to such a direct contract (or Owner, if Owner is performing the additional work with Owner's employees) proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work, and shall properly connect and coordinate the Work with theirs, Contractor shall do all cutting, fitting, and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected.
- C. If any part of Contractor's Work depends for proper execution or results upon the work of any such other contractor or utility owner (or Owner), Contractor shall inspect and promptly report to Engineer in writing any delays, defects, or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. Contractor's failure so to report will constitute an acceptance of the other work as fit and proper for integration with Contractor's Work except for latent or nonapparent defects and deficiencies in the other work.

7.02 COORDINATION:

- A. If Owner contracts with others for the performance of other work on the Project at the Site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified in the General Requirements, and the specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 COMMUNICATIONS:

- A. Owner shall issue all communications to Contractor through Engineer.

8.02 CHANGE OF ENGINEER:

- A. In case of termination of the employment of Engineer, Owner shall appoint an engineer against whom Contractor makes no reasonable objection, whose status under the Contract Documents

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shall be that of the former Engineer. Any dispute in connection with such appointment shall be subject to arbitration.

8.03 REQUIRED DATA:

- A. Owner shall furnish the data required of Owner under the Contract Documents promptly and shall make payments to Contractor promptly after they are due as provided in Paragraphs 14.04A and 14.09A.

8.04 LANDS AND EASEMENTS:

- A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.04.

8.05 INSURANCE:

- A. Owner's responsibilities in respect of purchasing and maintaining insurance are set forth in Paragraph 5.02.

8.06 CHANGE ORDERS:

- A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.01.

8.07 INSPECTIONS AND TESTS:

- A. Owner's responsibility in respect of certain inspections, tests and approvals is set forth in Paragraph 13.03B.

8.08 STOPPING THE WORK:

- A. In connection with Owner's right to stop Work or suspend Work, see Paragraphs 13.06 and 15.02. Paragraph 15.02A deals with Owner's right to terminate services of Contractor under certain circumstances.

8.09 LIMITATIONS ON OWNER'S RESPONSIBILITIES:

- A. Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE:

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of Owner and Engineer.

9.02 VISITS TO SITE:

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous on-Site inspections to check the quality or

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quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform to the Contract Documents. On the basis of such visits and on-Site observations as an experienced and qualified design professional, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defects and deficiencies in the Work.

9.03 PROJECT REPRESENTATION:

- A. Engineer will furnish Resident Project Representative and assistants to assist Engineer in observing the performance of the Work.
 - 1. Communications pertaining to Submittals, written interpretations, and Change Orders shall be directed to Engineer at his home office with copies to Resident Project Representative.
 - 2. Communications pertaining to day-to-day operations at the Site shall be directed to Resident Project Representative.
 - 3. Resident Project Representative and his assistants will conduct observations of the Work in progress to assist Engineer in determining that the Work is proceeding in accordance with the Contract Documents.
 - 4. Resident Project Representative will not have authority to permit any deviation from the Contract Documents, except with concurrence of Engineer.

9.04 CLARIFICATIONS AND INTERPRETATIONS:

- A. Engineer will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of drawings or otherwise) as Engineer may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If Contractor believes that a written clarification or interpretation justifies an increase in the Contract Price or an extension of the Contract Times and the parties are unable to agree to the amount or extent thereof, Contractor may make a claim therefor as provided in Article 11 or Article 12.

9.05 AUTHORIZED VARIATIONS IN WORK:

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner, and also on Contractor who shall perform the Work involved promptly.

9.06 REJECTING DEFECTIVE WORK:

- A. Engineer will have authority to disapprove or reject Work which Engineer believes to be defective, and will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.05B, whether or not the Work is fabricated, installed, or completed.
- B. Resident Project Representative will have authority, subject to final decision of Engineer, to disapprove or reject any defective workmanship, Equipment, or Material.

9.07 SUBMITTALS, CHANGE ORDERS, AND PAYMENTS:

- A. In connection with Engineer's responsibility for Submittals, see Paragraph 6.14.
- B. In connection with Engineer's responsibilities as to Change Orders, see Articles 10, 11, and 12.
- C. In connection with Engineer's responsibilities in respect of Applications for Payment, see Article 14.

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9.08 DETERMINATIONS FOR UNIT PRICES:

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise).
- B. Engineer's written decisions thereon will be final and binding upon Owner and Contractor, unless, within ten days after the date of any such decision, either Owner or Contractor delivers to the other party to the Agreement and to Engineer written notice of intention to appeal from such a decision.

9.09 DECISIONS ON DISPUTES:

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes, and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to Engineer in writing with a request for a formal decision in accordance with this Paragraph, which Engineer will render in writing within a reasonable time. Written notice of each such claim, dispute, and other matter will be delivered by the claimant to Engineer and the other party to the Agreement promptly (but in no event later than 30 days) after the occurrence of the event giving rise thereto, and written supporting data shall be delivered to Engineer and the other party within 60 days after such occurrence unless Engineer allows an additional period of time to ascertain more accurate data in support of the claim.
- B. When functioning as interpreter and judge under Paragraphs 9.08 and 9.09A, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by Engineer with respect to any such claim, dispute, or other matter except any which have been waived by the making or acceptance of final payment as provided in Paragraph 14.11 will be a condition precedent to any exercise by Owner or Contractor of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute, or other matter.

9.10 LIMITATIONS ON ENGINEER'S RESPONSIBILITIES:

- A. Neither Engineer's authority to act under this Article 9 or elsewhere in the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of Engineer to Contractor, any Subcontractor, any Supplier, or any other person or organization performing any of the Work, or to any surety for any of them.
- B. Whenever in the Contract Documents the terms "as directed", "as required", "as allowed", "as approved", or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper", or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review, or judgment of Engineer as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraphs 9.10C or 9.10D.

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- C. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.
- D. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.
- E. The presence or absence of Engineer or his representative will not act to relieve Contractor of any responsibility or of any guarantee of his performance. Neither will observation by Engineer or his representative in any way be understood to relieve Contractor of any responsibility for proper supervision of the Work at all times.
- F. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.08A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- G. The limitations upon authority and responsibility set forth in this Paragraph 9.10 shall also apply to Engineer's Consultants, Resident Project Representative, and assistants.

ARTICLE 10 - CHANGES IN THE WORK

10.01 GENERAL:

- A. Without invalidating the Agreement and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work; these will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which shall be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree as to the extent, if any, of an increase or decrease in the Contract Price or an extension or a shortening of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefore as provided in Article 11 or 12.
- C. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified, and supplemented as provided in Paragraphs 3.02A and 3.02C, except in the case of an emergency as provided in Paragraph 6.13 and except in the case of uncovering Work as provided in Paragraph 13.05B.
- D. Owner and Contractor shall execute appropriate Change Orders (or Written Amendments) covering:
 - 1. Changes in the Work which are ordered by Owner pursuant to Paragraph 10.01A, are required because of acceptance of defective Work under Paragraph 13.09 or correcting defective Work under Paragraph 13.10, or are agreed to by the parties;
 - 2. Changes in the Contract Price or Contract Times which are agreed to by the parties; and
 - 3. Changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 9.09A, provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in

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accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the progress schedule as provided in Paragraph 6.15.

- E. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be Contractor's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11 - CHANGE OF CONTRACT PRICE

11.01 GENERAL:

- A. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to Contractor for performing the Work. All duties, responsibilities, and obligations assigned to or undertaken by Contractor shall be at his expense without change in the Contract Price.
- B. The Contract Price may only be changed by a Change Order or a Written Amendment. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to Engineer promptly (but in no event later than 15 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within 60 days after such occurrence (unless Engineer allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by Engineer in accordance with Paragraph 9.09A if Owner and Contractor cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this Paragraph 11.01B.
- C. The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:
 - 1. On the basis of the Cost of the Work determined as provided in Paragraphs 11.02A and 11.02B plus a Contractor's Fee for overhead and profit (determined as provided in Paragraphs 11.03A and 11.03B).

11.02 COST OF THE WORK:

- A. The term Cost of the Work means the sum of all costs necessarily incurred and paid by Contractor in the proper performance of the Work. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in Paragraph 11.02B.
 - 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation, and holiday pay applicable thereto. Such employees shall include superintendents and

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foremen at the Site. The expenses of performing Work after regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all Equipment and Materials furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds, and all returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to the Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from Subcontractors acceptable to Contractor and shall deliver such bids to Owner who will then determine, with the advice of Engineer, which bids will be accepted. If a subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as Contractor's Cost of the Work. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Costs, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, installation, dismantling, and removal thereof - all in accordance with terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, or similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages and related expenses, not compensated by insurance or otherwise, to the Work or otherwise sustained by Contractor in connection with the performance and furnishing of the Work provided they have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the cost of the Work for the purpose of determining Contractor's fee. If, however, any such loss or damage requires reconstruction and Contractor is placed in charge

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thereof, Contractor shall be paid for services a fee proportionate to that stated in Paragraph 11.03A.1.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressage, and similar petty cash items in connection with the Work.
- i. Cost of premiums for additional Bonds and insurance required because of changes in the Work and premiums for property insurance coverage within the limits of the deductible amounts established by Owner in accordance with Paragraph 5.02D.

B. The term Cost of the Work shall not include any of the following:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor whether at the Site or in Contractor's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.02A.1 or specifically covered by Paragraph 11.02A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work, and charges against Contractor for delinquent payments.
- 4. Cost of premiums for all Bonds and for all insurance whether or not Contractor is required by the Contract Documents to purchase and maintain the same.
- 5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 6. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 11.02A.

11.03 CONTRACTOR'S FEE:

A. The Contractor's Fee allowed to Contractor for overhead and profit shall be determined as follows:

- 1. A fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 11.02A.1 and 11.02A.2, the Contractor's Fee shall be 15%;
 - b. For costs incurred under Paragraph 11.02A.3, the Contractor's Fee shall be 5%; and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to Contractor on account of overhead and profit of all Subcontractors shall be 15%;
 - c. No fee shall be payable on the basis of costs itemized under Paragraph 11.02A.4, 11.02A.5 and 11.02B;
 - d. The amount of credit to be allowed by Contractor to Owner for any such change which results in a net decrease in cost will be the amount of the actual net decrease plus a deduction in Contractor's Fee by an amount equal to 10% of the net decrease; and
 - e. When both additions and credits are involved in any one change, the adjustment in Contractor's Fee shall be computed on the basis of the net change, inclusive.

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- B. Whenever the cost of any Work is to be determined pursuant to Paragraph 11.02A or 11.02B, Contractor will submit in form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.04 CASH ALLOWANCES: (NOT APPLICABLE)

11.05 UNIT PRICE WORK: (NOT APPLICABLE)

11.06 ELECTRONIC EQUIPMENT COMPLIANCE:

- A. In no event shall Contractor be entitled to an increase in the Contract Price based upon any failure or delay by Contractor in supplying equipment, materials, work, or services that are electronically compliant or failure or delay by Contractor's Subcontractors or Suppliers in providing equipment, materials, work, or services as a result of Subcontractors' or Suppliers' lack of electronic equipment compliance in their own operations, systems, or processes used to provide or deliver equipment, material, work, or services.

11.07 RIGHT OF AUDIT:

- A. Owner shall have the right to inspect and audit all of Contractor's books, records, correspondence, instructions, drawings, receipts, payment records, vouchers, and memoranda relating to the Work, and Contractor shall preserve all such records and supporting documentation for a period of three years after date of Final Payment. Contractor hereby grants to Owner the authority to enter Contractor's premises for the purpose of inspection of such records and supporting documentation or, at Contractor's option, Contractor may make such records and supporting documentation available to Owner at a location satisfactory to Owner.
- B. All of the records and supporting documentation shall be open to inspection and subject to audit and reproduction by Owner or its authorized representative for any and all purposes, including but not limited to (i) compliance with the Contract Documents; (ii) proper pricing of Change Orders; and (iii) claims submitted by or against Contractor or any Subcontractor or Supplier in connection with any performance under the Contract Documents.

ARTICLE 12 - CHANGE OF CONTRACT TIMES

12.01 GENERAL:

- A. The Contract Times may only be changed by a Change Order or a Written Amendment. Contractor, in undertaking to complete the Work within the Contract Times, shall take into consideration and make allowances for all of the ordinary delays and hindrances incident to such Work, whether growing out of delays in securing equipment or materials or workmen or otherwise.
- B. Adjustments to the Contract Times will be made for delays in completion of the Work from causes beyond Contractor's control, including the following:
 1. Federal embargoes, priority orders, or other restrictions imposed by the United States Government.
 2. Unusual delay in fabrication or shipment of Equipment or Materials required in the Work, whether ordered by Contractor or furnished by Owner or others under separate contract.
 3. Strikes and other labor disputes.
 4. Delays caused by court proceedings.
 5. Change Orders.

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6. Neglect, delay, or default of any other contractor employed by Owner.
 7. Unusual construction delays resulting from weather conditions abnormal to the geographical area and to the season of the year such as above normal continuous days of precipitation, above normal amount of precipitation within a 24 hour period, or above normal days of extreme cold or hot temperature conditions affecting installation/application due to manufacturers or specifications limitations. These conditions will not be cause for extensions of time if abnormal weather conditions do not affect the stage of construction. All claims for extension of time due to abnormal weather conditions must be substantiated with evidence from a weather bureau or other authoritative source. Weather conditions normal to the geographical area and to the season of the year shall be taken into consideration in the Bid. Normal conditions shall be defined as the average number of days, amounts, or both over a 5-year period averaged per season.
 8. Conflicts, errors or discrepancies in the Contract Documents reported to Engineer as provided in these General Conditions.
 9. Any failure or delay by Contractor in supplying equipment, materials, work, or services that are electronically compliant or failure or delay by Contractor's Subcontractors or Suppliers in providing equipment, materials, work, or services as a result of Subcontractors' or Suppliers' lack of electronic equipment compliance in their own operations, systems, or processes used to provide or deliver equipment, material, work, or services shall not be considered to be caused by events beyond Contractor's control. Such electronic equipment compliance problems shall not constitute a basis for delay in completion of the Work, adjustment to the Contract Times, or an excuse for Contract nonperformance.
- C. The Contractor shall allow for weather delays in their schedule. The total number of weather delay days the Contractor is allowed each month is listed in paragraph 12.01.D. The Contractor may submit by the 15th day of the following month any claims for weather delays beyond the normal number experienced in the previous month. To claim the number of days that has caused a delay in the schedule the weather delay days must meet the following requirements:
1. The work impacted must be on the critical path schedule.
 2. The weather must have impacted more than 4 hours of work the day in question.
 3. The day in question must have occurred during normal working days of Monday through Friday. Saturday work is not eligible for a weather delay claim. In addition, a Contractor is not allowed to work on Sundays or Holidays, therefore they are not eligible for weather delay claims.
 4. The Owner must concur that a weather delay has been experienced by the Contractor.
 5. The Contractor shall submit per paragraph 12.01.C a listing of the days in question that includes the following:
 - a. The month, date, and day of the week.
 - b. The reason for the weather delay.
 - c. The critical path work impacted by the weather delay.
 - d. A place in the listing for the Owner to sign and date their concurrence that the weather delay has occurred for each day being claimed.
- D. The number of days defined as the normal number of work days each month to be allowed for weather delays are as follows:
1. January – 7 days.
 2. February – 6 days.
 3. March – 5 days.

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4. April – 4 days.
 5. May – 3 days.
 6. June – 4 days.
 7. July – 3 days.
 8. August – 3 days.
 9. September – 3 days.
 10. October – 4 days.
 11. November – 3 days.
 12. December – 6 days.
- E. If the Contractor experience a number of weather delay days in any given month that are less than the number provided in 12.01.D the number of days or the completion date defined in the Agreement will not be decreased.
- F. Owner shall award extensions of the Contract Times on account of such causes of delay, provided that adequate evidence is presented to enable Engineer to determine with exactness the extent and duration of delay for each item involved.
- G. No extension to the Contract Times will be granted for delays involving only portions of the Work, or which do not directly affect the time required for completion of the entire Work.
- H. Any claim for an extension to the Contract Times shall be delivered in writing to Owner and Engineer within 15 days of the occurrence of the event giving rise to the claim. All claims for adjustment to the Contract Times will be determined by Engineer if Owner and Contractor cannot otherwise agree. Any change to the Contract Times resulting from any such claim will be incorporated in a Change Order or a Written Amendment.
- I. All time limits stated in the Contract Documents are of the essence of the Agreement. The provisions of this Article 12 shall not exclude recovery for damages (including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and court and arbitration costs) for delay by either party.

ARTICLE 13 - WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

13.01 WARRANTY AND GUARANTEE:

- A. Contractor warrants and guarantees to Owner and Engineer that all Work will be in accordance with the Contract Documents and will not be defective. Prompt notice of all defects shall be given to Contractor. All defective Work, whether or not in place, may be rejected, corrected or accepted as provided in this Article 13.
- B. No provision in the Contract Documents nor any specified guarantee time limit shall be held to limit Contractor's liability for defects to less than the legal limit of liability in accordance with the Law.
- C. All Equipment and Materials furnished by Contractor for the Work shall carry a written guarantee from the manufacturer or Supplier of such items when called for in the Specifications. Written guarantees shall be submitted to Engineer with other Submittals. Engineer will transmit such guarantees to Owner for review.

13.02 ACCESS TO THE WORK:

- A. Engineer and Engineer's representatives, other representatives of Owner, testing agencies, and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide proper and safe conditions for such access.

13.03 TESTS AND INSPECTIONS:

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03C and 13.03D below;
 - 2. that costs incurred in connections with tests or inspections conducted pursuant to Paragraph 13.05B shall be paid as provided in said Paragraph 13.05B; and
 - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested, or approved, Contractor shall assume full responsibility therefor, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection, testing, or approval.
- D. Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with Owner's or Engineer's acceptance of a Supplier of Materials or Equipment proposed to be incorporated in the Work, or of Materials or Equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.
 - 1. Contractor shall be responsible for and shall pay all costs in connection with any re-inspection or re-testing required if initial inspection or test fails
- E. All inspections, tests, or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations acceptable to Owner and Contractor or by Engineer if so specified.
- F. If any Work (including the work of others) that is to be inspected, tested, or approved is covered without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation. Such uncovering shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.
- G. Neither observations by Engineer nor inspections, tests, or approvals by others shall relieve Contractor from Contractor's obligations to perform the Work in accordance with the Contract Documents.

13.04 DEFECTIVE WORK:

- A. The term "defective" is used in these documents to describe Work that is unsatisfactory, faulty, not in conformance with the requirements of the Contract Documents, or not meeting the requirements of any inspection, test, approval, or acceptance required by Law or the Contract Documents.
- B. Any defective Work may be disapproved or rejected by Engineer at any time before final acceptance even though it may have been overlooked and included in a previous Application for Payment.
- C. Prompt notice will be given by Engineer to Contractor of defects as they become evident.

13.05 UNCOVERING WORK:

- A. If any Work is covered contrary to the written request of Engineer, it shall, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. If it

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is found that such Work is defective, Contractor shall bear all direct, indirect, and consequential costs of such uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction, (including but not limited to fees and charges of engineers, architects, attorneys, and other professionals); and Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefor as provided in Article 11. If, however, such Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, Contractor may make a claim therefor as provided in Articles 11 and 12.

13.06 OWNER MAY STOP THE WORK:

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor or any other party.

13.07 CORRECTION OR REMOVAL OF DEFECTIVE WORK:

- A. If required by Engineer, Contractor shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by Engineer, remove it from the Site and replace it with nondefective Work. Contractor shall bear all direct, indirect, and consequential costs of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys, and other professionals) made necessary thereby.

13.08 ONE-YEAR CORRECTION PERIOD:

- A. If within one year after the Date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions, either correct such defective Work, or, if it has been rejected by Owner, remove it from the Site and replace it with nondefective Work. If Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or the rejected Work removed and replaced, and all direct, indirect, and consequential costs of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys, and other professionals) will be paid by Contractor. In special circumstances where a particular item of Equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

13.09 ACCEPTANCE OF DEFECTIVE WORK:

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, also Engineer) prefers to accept it, Owner may do so. Contractor shall bear all direct, indirect, and consequential costs attributable to Owner's evaluation of and determination to accept such defective Work (such

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costs to be approved by Engineer as to reasonableness and to include but not be limited to fees and charges of engineers, architects, attorneys, and other professionals). If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, Owner may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.10 OWNER MAY CORRECT DEFECTIVE WORK:

- A. If Contractor fails within a reasonable time after written notice of Engineer to proceed to correct and to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.07, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days' written notice to Contractor, correct and remedy any such deficiency. In exercising the rights and remedies under this Paragraph, Owner shall proceed expeditiously.
- B. To the extent necessary to complete corrective and remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work, and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment, and machinery at the Site and incorporate in the Work all Equipment and Materials stored at the Site or for which Owner has paid Contractor but which are stored elsewhere.
- C. Contractor shall allow Owner, Owner's representatives, agents, and employees such access to the Site as may be necessary to enable Owner to exercise the rights and remedies under this Paragraph.
- D. All direct, indirect, and consequential costs of Owner in exercising such rights and remedies will be charged against Contractor in an amount approved as to reasonableness by Engineer, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, Owner may make a claim therefor as provided in Article 11. Such direct, indirect, and consequential costs will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, all court and arbitration costs, and all costs of repair and replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- E. Contractor shall not be allowed an extension of the Contract Times because of any delay in performance of the Work attributable to the exercise by Owner of Owner's rights and remedies hereunder.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 SCHEDULE OF VALUES:

- A. The schedule of values established will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

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14.02 APPLICATION FOR PROGRESS PAYMENT:

- A. At least 20 days before each progress payment is scheduled (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
- B. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
- C. If payment is requested on the basis of Equipment and Materials not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the Equipment and Materials free and clear of all liens, charges, security interests, and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the Equipment and Materials are covered by appropriate property insurance and other arrangements to protect Owner's interest therein, all of which will be satisfactory to Owner.
- D. The amount of retainage with respect to progress payments will be as stipulated in Paragraph 14.04G.

14.03 CONTRACTOR'S WARRANTY OF TITLE:

- A. Contractor warrants and guarantees that title to all Work, Materials, and Equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 REVIEW OF APPLICATION FOR PROGRESS PAYMENT:

- A. Engineer will, within ten days after receipt of each Application For Payment, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application. Ten days after presentation of the Application for Payment with Engineer's recommendation, the amount recommended will (subject to the provisions of the last sentence of Paragraph 14.04D) become due and when due will be paid by Owner to Contractor.
- B. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's on-Site observations of the Work in progress as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules that the Work has progressed to the point indicated; that, to the best of Engineer's knowledge, information, and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.08, and to any other qualifications stated in the recommendation); and that Contractor is entitled to payment of the amount recommended. However, by recommending any such payment, Engineer will not thereby be deemed to have represented that exhaustive or continuous on-Site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents, or that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or Owner to withhold payment to Contractor.

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- C. Engineer's recommendation of final payment will constitute an additional representation by Engineer to Owner that the conditions precedent to Contractor's being entitled to final payment as set forth in Paragraph 14.09 have been fulfilled.
- D. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make such representations to Owner. Engineer may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
 - 1. The Work is defective, or completed Work has been damaged requiring correction or replacement.
 - 2. Written claims have been made against Owner or Liens have been filed in connection with the Work.
 - 3. The Contract Price has been reduced by Written Amendment or Change Order.
 - 4. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.10, or
 - 5. Of Engineer's actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02B.
 - 6. Of Contractor's unsatisfactory prosecution of the Work in accordance with the Contract Documents.
 - 7. Contractor's failure to make payment to Subcontractors, or for labor, Materials, or Equipment.
- E. Owner may refuse to make payment of the full amount recommended by Engineer because claims have been made against Owner on account of Contractor's performance of furnishing of the Work, or Liens have been filed in connection with the Work, or there are other items entitling Owner to a set-off against the amount recommended, but Owner must give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action.
- F. When all grounds for withholding payment are removed, payment will be made in the amounts withheld because of them.
- G. Progress payments will be in the amount of 90% of the amount of the Application for Payment less the sum of all previous payments. When the amount retained by Owner becomes equal to 5% of the Contract Price, the remaining progress payments will be made in full, provided Contractor's performance is satisfactory in the opinions of Engineer and Owner.

14.05 SUBSTANTIAL COMPLETION:

- A. When Contractor considers the entire Work ready for its intended use, Contractor will notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Within a reasonable time thereafter, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving his reasons therefor. If Engineer considers the Work substantially complete, Engineer will prepare and deliver to Owner a tentative certificate of Substantial Completion which will fix the Date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment.
- C. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete,

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- Engineer will within fourteen days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said fourteen days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, heat, utilities, insurance, and warranties.
 - E. Unless Owner and Contractor agree otherwise in writing and so inform Engineer prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
 - F. Owner shall have the right to exclude Contractor from the Work after the Date of Substantial Completion, but Owner shall allow Contractor reasonable access to complete or correct items on the tentative list.

14.06 PARTIAL UTILIZATION:

- A. Use by Owner of any finished part of the Work, which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and useable part of the Work that can be used by Owner without significant interference with Contractor's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:
 - 1. Owner at any time may request Contractor in writing to permit Owner to use any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If Contractor agrees, Contractor will certify to Owner and Engineer that said part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.05 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 2. Owner may at any time request Contractor in writing to permit Owner to take over operation of any such part of the Work although it is not substantially complete. A copy of such request will be sent to Engineer and within a reasonable time thereafter, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If Contractor does not object in writing to Owner and Engineer that such part of the Work is not ready for separate operation by Owner, Engineer will finalize the list of items to be completed or corrected and will deliver such list to Owner and Contractor together with a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to

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security, operation, safety, maintenance, utilities, insurance, warranties, and guarantees for that part of the Work, which will become binding upon Owner and Contractor at the time when Owner takes over such operation (unless they shall have otherwise agreed in writing and so informed Engineer). During such operation and prior to Substantial Completion of such part of the Work, Owner shall allow Contractor reasonable access to complete or correct items on said list and to complete other related Work.

3. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of Paragraph 5.02I in respect of property insurance.

14.07 FINAL INSPECTION:

- A. Upon written notice from Contractor that the Work or an agreed portion thereof is complete, Engineer will make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to remedy such deficiencies.

14.08 FINAL APPLICATION FOR PAYMENT:

- A. After Contractor has completed all such corrections to the satisfaction of Engineer and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents, and other documents - all as required by the Contract Documents, and after Engineer has indicated that the Work is acceptable (subject to the provisions of Paragraph 14.11), Contractor may make application for final payment following the procedure for progress payments.
- B. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, together with complete and legally effective releases or waivers (satisfactory to Owner) of all Liens arising out of or filed in connection with the Work. In lieu thereof and as approved by Owner, Contractor may furnish receipts or releases in full; an affidavit of Contractor that the releases and receipts include all labor, services, Material, and Equipment for which a Lien could be filed, and that all payrolls, Equipment and Material bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible, have been paid or otherwise satisfied; and consent of the surety, if any, to final payment. If any Subcontractor or Supplier fails to furnish a release or receipt in full, Contractor may furnish a Bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

14.09 FINAL PAYMENT AND ACCEPTANCE:

- A. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation--all as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application to Owner for payment. Thereupon, Engineer will give written notice to Owner and Contractor that the Work is acceptable (subject to the provisions of Paragraph 14.11). Otherwise, Engineer will return the Application to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Thirty days after presentation to Owner of the Application and accompanying documentation, in appropriate form and substance, and with

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Engineer's recommendation and notice of acceptability, the amount recommended by Engineer will become due and will be paid by Owner to Contractor.

- B. If, through no fault of Contractor, final completion of the Work is significantly delayed and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment and recommendation of Engineer, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. The written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

14.10 CONTRACTOR'S CONTINUING OBLIGATION:

- A. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by Engineer, nor the issuance of a certificate of Substantial Completion, nor any payment by Owner to Contractor under the Contract Documents, nor any use or occupancy of the Work or any part thereof by Owner, nor any act of acceptance by Owner nor any failure to do so, nor any review and approval of a Submittal, nor the issuance of a notice of acceptability by Engineer pursuant to Paragraph 14.09, nor any correction of defective Work by Owner will constitute an acceptance of Work not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents (except as provided in Paragraph 14.11).

14.11 WAIVER OF CLAIMS: The making and acceptance of final payment will constitute:

- A. A waiver of all claims by Owner against Contractor, except claims arising from unsettled Liens, from defective work appearing after final inspection pursuant to Paragraph 14.07, or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by Owner of any rights in respect of Contractor's continuing obligations under the Contract Documents; and
- B. A waiver of all claims by Contractor against Owner other than those previously made in writing and still unsettled.

14.12 INTEREST:

- A. All moneys not paid to Contractor or to Owner when due shall bear interest at the legal rate in force at the place of the Project.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 OWNER MAY SUSPEND WORK:

- A. Owner may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than 90 days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to any suspension if Contractor makes an approved claim therefor as provided in Articles 11 and 12.

15.02 OWNER MAY TERMINATE:

- A. Upon the occurrence of any one or more of the following events:

DOCUMENT 007200 - GENERAL CONDITIONS: continued

1. If Contractor commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if Contractor takes any equivalent or similar action by filing a petition or otherwise under any other federal or state Law in effect at such time relating to the bankruptcy or insolvency;
 2. If a petition is filed against Contractor under any chapter of the bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against Contractor under any other federal or state Law in effect at the time relating to bankruptcy or insolvency;
 3. If Contractor makes a general assignment for the benefit of creditors;
 4. If a trustee, receiver, custodian, or agent of Contractor is appointed under applicable Law or under contract, whose appointment or authority to take charge of property of Contractor is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of Contractor's creditors;
 5. If Contractor admits in writing an inability to pay its debts generally as they become due;
 6. If Contractor persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable Equipment or Materials or failure to adhere to the progress schedule established under Paragraph 2.07 as revised from time to time);
 7. If Contractor disregards Laws or Regulations of any public body having jurisdiction;
 8. If Contractor disregards the authority of Engineer; or
 9. If Contractor otherwise violates in any substantial way any provisions of the Contract Documents;
- B. Owner may, after giving Contractor (and the surety, if there be one) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of Contractor, exclude Contractor from the Site and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion), incorporate in the Work all Equipment and Materials stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and finish the Work as Owner may deem expedient. In such case, 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, indirect, and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and court and arbitration costs), such excess will be paid to Contractor. If such costs exceed such unpaid balance, Contractor shall pay the difference to Owner. Such costs incurred by Owner will be approved as to reasonableness by Engineer and incorporated in a Change Order, but when exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- C. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due to Contractor by Owner will not release Contractor from liability.
- D. Upon seven days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Agreement. In such case, Contractor shall be paid for all Work executed and any expense sustained plus reasonable termination expenses, which will include, but not be limited to, direct, indirect, and consequential costs (including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals, and court and arbitration costs).

DOCUMENT 007200 - GENERAL CONDITIONS: continued

15.03 CONTRACTOR MAY STOP WORK OR TERMINATE:

- A. If, through no act or fault of Contractor, the Work is suspended for a period of more than 90 days by Owner or under an order of court or other public authority, or Engineer fails to act on any Application for Payment within 30 days after it is submitted, or Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days' written notice to Owner and Engineer, terminate the Agreement and recover from Owner payment for all Work executed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Agreement, if Engineer has failed to act on an Application for Payment or Owner has failed to make any payment as aforesaid, Contractor may upon seven days' written notice to Owner and Engineer stop the Work until payment of all amounts then due. The provisions of this Paragraph shall not relieve Contractor of the obligations under Paragraph 6.15 to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with Owner.

ARTICLE 16 - RESOLUTION OF DISPUTES

16.01 ARBITRATION: (NOT APPLICABLE)

ARTICLE 17 - MISCELLANEOUS

17.01 GIVING NOTICE:

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given 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 at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 COMPUTATION OF TIME:

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the Law of the applicable jurisdiction, such day will be omitted from the computation.
- B. A calendar day of 24 hours measured from midnight to the next midnight shall constitute a day.

17.03 CLAIMS, CUMULATIVE REMEDIES:

- A. Should Owner or Contractor suffer injury or damage to person or property because of any error, omission, or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this Paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.
- B. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon Contractor by Paragraphs 6.16A, 13.01, 13.08, 13.10, 14.03, and 15.02A and all of the rights and remedies available to Owner and Engineer thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of

DOCUMENT 007200 - GENERAL CONDITIONS: continued

the Contract Documents, and the provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply. All representations, warranties, and guarantees made in the Contract Documents will survive final payment and termination or completion of the Agreement.

END OF DOCUMENT 007200

| | | |
|----------------------------------|----------|------|
| OPERATOR: Crane..... | \$ 19.26 | 0.00 |
| OPERATOR: Loader (Front End).... | \$ 12.94 | 0.00 |
| OPERATOR: Mechanic..... | \$ 17.25 | 0.00 |
| OPERATOR: Piledriver..... | \$ 17.21 | 0.00 |
| OPERATOR: Scraper..... | \$ 9.00 | 0.00 |
| OPERATOR: Tractor..... | \$ 11.13 | 0.00 |
| OPERATOR: Trencher..... | \$ 14.76 | 0.00 |
| PAINTER: Spray..... | \$ 20.15 | 3.50 |
| TRUCK DRIVER..... | \$ 9.00 | 0.00 |

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that

no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

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SECTION 01 11 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section summarizes the Work covered in detail in the complete Contract Documents.
- B. Owner: City of Fort Smith, Arkansas is contracting for Work described in the Contract Documents.
 - 1. Contract Identification: Lake Fort Smith and Lee Creek Fluoride Feed Systems – Contract 14-10-C1
 - 2. Work Site Location: Lake Fort Smith Water Treatment Plant (WTP) near Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas.
- C. Engineer: The Contract Documents were prepared by Burns & McDonnell Engineering Company, Inc., 9400 Ward Parkway, Kansas City, Missouri 64114.
- D. Project Coordinator: Owner will serve as Project Coordinator.

1.02 PROJECT DESCRIPTION:

- A. Description of Project: The construction of fluoride storage and feed facilities at the Lake Fort Smith Water Treatment Plant (WTP) near Mountainburg, Arkansas and the Lee Creek WTP in Van Buren, Arkansas.

1.03 CONTRACTOR'S USE OF PREMISES:

- A. Limited Use:
 - 1. Limit use of the premises for storage and execution of the Work to allow for Owner occupancy. Confine operations to areas within Contract limits indicated. Portions of Site outside the Contract limits shall not be disturbed.
 - 2. Coordinate with other separate contractors and Owner to avoid interference of operations.
 - 3. Conduct operations so as to ensure the least inconvenience to Owner and the general public.

1.04 OWNER'S USE OF PREMISES:

- A. Full Owner Occupancy: The Owner will occupy the Site during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations.
- B. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building, prior to Substantial Completion provided that such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

1.05 WORK SEQUENCE:

- A. General: Construction sequence shall be determined by Contractor subject to Owner's need for continuous operation of existing facilities.
- B. Continuous Service of Existing Facilities: Exercise caution and schedule operations to ensure that functioning of present facilities will not be disrupted. Shutdown of Owner's operating facilities to perform the Work shall be held to a minimum length of time and shall be coordinated with Owner who shall have control over the timing and schedules of such shutdowns.

1.06 MEASUREMENT AND PAYMENT:

- A. Lump Sum Contracts: All Work indicated and specified in the Contract Documents shall be included in the Lump Sum Contract Price.

SECTION 01 11 00 - SUMMARY OF WORK: continued

1.07 COPIES OF DOCUMENTS:

- A. Furnished Copies: After execution of Agreement, Contractor will be furnished at no cost, a maximum of four sets of Contract Documents consisting of full-size Contract Drawings including revised Drawings (and schedules), and the Project Manual, in addition to those used in execution of the Agreement.
- B. Additional Copies: Additional copies of above documents will be supplied by Engineer upon request at printing and delivery cost.

1.08 LIST OF DRAWINGS (AND SCHEDULES):

- A. Contract Drawings:
 - 1. Each sheet of the Contract Drawings bears the following general title: Lee Creek & Lake Fort Smith Water Treatment Plants Fluoride Feed Systems.
 - 2. Individual sheet numbers and titles are as stated on index sheet under "Contract Drawings".

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION – NOT APPLICABLE.

END OF SECTION 01 11 00

SECTION 01 31 00 – PROJECT COORDINATION AND MEETINGS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Project meetings.
 - 2. Requests for information (RFIs).

1.02 RELATED REQUIREMENTS:

- A. For preparing and submitting Contractor's construction progress schedule: Section 01 32 00.
- B. For Submittal Requirements: Section 01 33 00.
- C. For coordinating closeout of the Contract: Section 01 78 00.

1.03 DEFINITIONS:

- A. RFI: Request for information prepared by Contractor and submitted to Engineer seeking interpretation or clarification of the Contract Documents.

1.04 COORDINATION:

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to allow optimum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Where availability of space is limited, coordinate installation of different components to allow optimum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of others to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of construction progress schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of Submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
 - 9. Project closeout activities.

SECTION 01 31 00 – PROJECT COORDINATION AND MEETINGS: continued

1.05 PROJECT MEETINGS:

- A. Preconstruction Conference:
1. Engineer will conduct a meeting within 20 days after the Effective Date of the Agreement, to review items stated in the following agenda and to establish a working understanding between the parties as to their relationships during performance of the Work.
 2. Preconstruction conference shall be attended by:
 - a. Representative(s) of Contractor including Contractor's superintendent.
 - b. Engineer.
 - c. Representative(s) of Owner.
 - d. At Owner's option, representatives of principal Subcontractors and Suppliers.
 3. Meeting Agenda:
 - a. Construction schedules.
 - b. Phasing.
 - c. Critical Work sequencing and long-lead items.
 - d. Designation of key personnel and their duties; lines of communication.
 - e. Project coordination.
 - f. Procedures and Processing of:
 - (1) RFIs.
 - (2) Field decisions.
 - (3) Substitutions.
 - (4) Submittals.
 - (5) Change Orders.
 - (6) Applications for Payment.
 - g. Procedures for testing.
 - h. Procedures for preparing and maintaining record documents.
 - i. Use of Premises:
 - (1) Office, work, storage, laydown, and parking areas.
 - (2) Owner's requirements.
 - (3) Work restrictions and hours.
 - j. Construction facilities, controls, and construction aids.
 - k. Temporary utilities.
 - l. Safety and first-aid.
 - m. Security.
 - n. Deliveries of Equipment and Materials.
 4. Location of Meeting: At or near the Project Site.
 5. Reporting:
 - a. Within five working days after the meeting, Engineer will prepare and distribute minutes of the meeting to Owner and Contractor.
 - b. Contractor shall provide copies to Subcontractors and major Suppliers.
- B. Coordination Schedules:
1. Engineer will conduct a meeting at least ten days before submission of the first Application for Payment to finalize the initial coordination schedules requested under Section 01 32 00 - Construction Progress Schedules And Reports.
 2. The meeting shall be attended by:
 - a. Representative(s) of Contractor including Contractor's superintendent.
 - b. At Owner's option, representatives of principal Subcontractors and Suppliers.
 - c. Engineer.
 - d. Representative(s) of Owner.

SECTION 01 31 00 – PROJECT COORDINATION AND MEETINGS: continued

- C. Construction Progress Meetings:
1. Engineer will schedule and conduct a meeting at least monthly and at other times requested by Engineer. Representatives of the Owner, Engineer, and Contractor shall be present at each meeting. With Engineer's concurrence, Contractor may request attendance by representatives of Subcontractors, Suppliers, or other entities concerned with current program or involved with planning, coordination, or performance of future activities. All participants in the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
 2. Contractor and each Subcontractor represented shall be prepared to discuss the current construction progress report and any anticipated future changes to the schedule. Each Subcontractor shall comment on the schedules of Contractor and other Subcontractors and advise if their current progress or anticipated activities are compatible with that Subcontractor's Work.
 3. If one Subcontractor is delaying another, Contractor shall issue such directions as are necessary to resolve the situation and promote construction progress.
 4. Meeting Agenda:
 - a. Review of construction progress since previous meeting.
 - b. Field observations, interface requirements, conflicts.
 - c. Issues which may impede construction schedule.
 - d. Off-Site fabrication.
 - e. Delivery schedules.
 - f. Submittal schedules and status.
 - g. Site use; coordination with other contractors.
 - h. Temporary facilities, controls, and services.
 - i. Hours of Work.
 - j. Hazards and risks.
 - k. Housekeeping.
 - l. Quality and Work standards.
 - m. RFIs.
 - n. Status of Change Orders.
 - o. Documentation of information for payment requests.
 - p. Corrective measures and procedures to regain construction schedule if necessary.
 - q. Revisions to construction schedule.
 - r. Review of proposed activities for succeeding Work period.
 - s. Review proposed Contract modifications for:
 - (1) Effect on construction schedule and on completion date.
 - t. Other business.
 5. Location of Meetings: At or near Project Site.
 6. Reporting:
 - a. Within five working days after each meeting, Engineer will prepare and distribute minutes of the meeting to Owner and Contractor.
 - b. Contractor shall distribute copies to principal Subcontractors and Suppliers.
- D. Preinstallation Conferences:
1. Contractor shall conduct a preinstallation conference at the Project Site before each construction activity that requires coordination with other construction and where required in Divisions 02 through 46.
 2. Installer and representatives of manufacturers and fabricators, of products furnished by this Contract or by others, involved in or affected by the installation Work and its

SECTION 01 31 00 – PROJECT COORDINATION AND MEETINGS: continued

- coordination or integration with other materials and installations, shall attend the meeting. Advise Engineer of scheduled meeting dates.
3. Record significant discussions and agreements and disagreements of each conference. Distribute the minutes of the meeting within 3 working days after the meeting to everyone concerned, including Owner and Engineer.
 4. Do not proceed with the installation if disagreements arise during the conference which cannot be successfully resolved at the time. Contractor shall take actions necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.
- E. Startup Coordination Meetings:
1. Engineer will conduct daily startup coordination meetings at the Site with prime contractors. Regular meetings will be held starting when Contractor's Work begins commissioning and startup activities and will continue until Substantial Completion is achieved. Contractor and its major Subcontractors shall attend and participate in the meetings.
 2. Agenda:
 - a. Review of commissioning progress.
 - b. Safety, hazard, and risk consideration.
 - c. Startup observations and deviations from procedures.
 - d. Coordination among multiple prime contractors as applicable.
 - e. Issues that may impede startup.
 - f. Construction interfaces affecting startup.
 - g. Delivery schedules.
 - h. Performance and acceptance testing.
 - i. System Integration.
 - j. Quality assurance and quality control issues.
 - k. Corrective and/or warranty issues.
 - l. Other items as appropriate.
- 1.06 REQUESTS FOR INFORMATION (RFI):
- A. Procedure: Promptly on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI with the content specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's Work or work of Subcontractors.
 - B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Contract number and title.
 5. Name of Engineer.
 6. RFI number, numbered sequentially.
 7. Specification Section number and title and related paragraphs, as appropriate.
 8. Drawing number and detail references, as appropriate.
 9. Field dimensions and conditions, as appropriate.

SECTION 01 31 00 – PROJECT COORDINATION AND MEETINGS: continued

10. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Times or the Contract Price, Contractor shall state impact in the RFI.
 11. Contractor's signature.
 12. Attachments: Include drawings, descriptions, measurements, photos, product data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
- C. Hard-Copy RFIs:
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Engineer's Action: Engineer will review each RFI, determine action required, and return it. Allow seven working days for Engineer's response for each RFI. RFIs received after 1:00 p.m. local time will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of Submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Times or the Contract Price.
 - e. Requests for interpretation of Engineer's actions on Submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Multiple RFIs addressing similar or identical issues may be addressed by Engineer with a single broad response.
 3. Engineer's action may include a request for additional information, in which case Engineer's time for response will start again upon Contractor's response and resubmittal.
 4. If Contractor believes the RFI response warrants change in the Contract Times or the Contract Price, notify Engineer in writing within ten days of receipt of the RFI response.
- F. On receipt of Engineer's action, update the RFI log and promptly distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Log may be in electronic Adobe Acrobat PDF format. Electronic log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Contractor representative name and telephone number.
 4. Name and address of Engineer.
 5. RFI number including RFIs that were dropped and not submitted.
 6. RFI description.
 7. Date the RFI was submitted.
 8. Date Engineer's response was received.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 01 31 00

SECTION 01 32 00 – CONSTRUCTION PROGRESS SCHEDULES AND REPORTS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary construction progress schedule.
 - 2. Construction progress schedule.
 - 3. Schedule of Submittals.
 - 4. Schedule of values.
 - 5. Construction progress reports.
 - 6. Daily construction reports.
 - 7. Equipment and Material location reports.
 - 8. Field condition reports.
 - 9. Special reports.

1.02 RELATED REQUIREMENTS:

- A. For submitting and distributing meeting and conference minutes: Section 01 31 00 – "Project Coordination and Meetings."
- B. For submitting schedules and reports: Section 01 33 00 – "Submittals."
- C. For submitting construction photographs: Section 01 32 33 – "Project Photographs."

1.03 REFERENCE STANDARDS:

- A. Associated General Contractor's of America (AGC):
 - 1. Construction Planning and Scheduling.

1.04 DEFINITIONS:

- A. Activity: A discrete part of a contract that can be identified for planning, scheduling, monitoring, and controlling the construction Work. Activities included in a construction schedule consume time and resources, but shall not include planned work stoppages. Activities shall not normally reflect the Work of more than one trade.
 - 1. Critical activities are activities on the critical path and have zero or negative float. Critical activities must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. "Baseline" schedule: The schedule submitted and accepted by Engineer for the Work.
- C. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Price, unless otherwise approved by Engineer.
- D. CPM: Critical path method (CPM), which is a method of planning and scheduling a construction contract where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Contract.
- E. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Contract duration and contains no float.
- F. Event: The starting or ending point of an activity. An event has no duration.
- G. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

SECTION 01 32 00 – CONSTRUCTION PROGRESS SCHEDULES AND REPORTS: continued

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting an intermediate deadline or the planned Contract completion date.
 - H. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
 - I. Milestone: A key or critical point in time for reference or measurement. A milestone has no duration.
 - J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
 - K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.
- 1.05 SUBMITTALS:
- A. Schedule of Submittals: Submit six hard copies of schedule. Arrange the following information in a tabular format:
 1. Scheduled date for first submittal.
 2. Specification Section number and title.
 3. Submittal category (technical or informational).
 4. Name of Subcontractor or Supplier.
 5. Description of the Work covered.
 6. Scheduled date for Engineer's final release or approval.
 - B. Preliminary Construction Progress Schedule: Submit six opaque hard copies.
 1. Acceptance of cost-loaded preliminary construction schedule will not constitute acceptance of schedule of values for cost-loaded activities.
 - C. Schedule of Values: Submit six hard copies prior to the preconstruction conference.
 1. Schedule of values shall contain estimated schedule of monthly applications for progress payment amounts to determine estimated cash flow for the project.
 - D. Construction Progress Reports: Submit four copies on monthly intervals.
 - E. Daily Construction Reports: Submit four copies at monthly intervals.
 - F. Material Location Reports: Submit three copies at monthly intervals with application for payment.
 - G. Field Condition Reports: Submit four copies at time of discovery of differing conditions.
 - H. Special Reports: Submit four copies at time of unusual event.
- 1.06 COORDINATION:
- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
 - B. Coordinate construction progress schedule with the schedule of values, list of subcontracts, schedule of Submittals, Material and Equipment procurement, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from parties involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

SECTION 01 32 00 – CONSTRUCTION PROGRESS SCHEDULES AND REPORTS: continued

PART 2 - PRODUCTS

2.01 SCHEDULE OF SUBMITTALS:

- A. Preparation: Submit a schedule of Submittals, arranged in chronological order by dates required by construction progress schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates as required in Section 01 33 00 – "Submittals."
 - 1. Coordinate Submittals schedule with list of subcontracts, the schedule of values, and "Baseline" construction progress schedule.
 - 2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include Submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of construction progress schedule.

2.02 CONTRACTOR'S CONSTRUCTION PROGRESS SCHEDULE, GENERAL:

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established in the Notice to Proceed to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each building floor or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 30 calendar days, unless specifically allowed by Engineer.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, Submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 – "Submittals" in schedule. Coordinate Submittal review times in Contractor's construction progress schedule with schedule of Submittals.
 - 4. Startup and Testing Time: Include not less than five days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.

SECTION 01 32 00 – CONSTRUCTION PROGRESS SCHEDULES AND REPORTS: continued

- h. Environmental control.
 - 3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and initial operation.
 - m. Performance, guarantee, and acceptance testing.
 - n. Placement into final use and operation.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
- G. Contract Modifications: For each proposed Contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall schedule.
- H. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules and is acceptable to Engineer:
 - 1. Primavera Project Planner (P3).
 - 2. Primavera 3e.
 - 3. Primavera 5.0.
 - 4. Sure Trak.
 - 5. Engineer-approved equal.

2.03 PRELIMINARY CONSTRUCTION PROGRESS SCHEDULE:

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established in the Notice to Proceed.
 - 1. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work.
- B. Preliminary Schedule of Values:
 - 1. Initiate a preliminary value assigned to each significant construction activity.
 - 2. Values shall give an indication of cash requirement prediction, with total equal to Contract Price.
 - 3. Submit within ten days of Effective Date of Contract to Engineer and Owner for review.
- C. Schedule of Estimated Monthly Applications for Progress Payments:
 - 1. Schedule shall show the estimated dollar amount of each monthly application for progress payment.
 - 2. Submit with schedule of values.

SECTION 01 32 00 – CONSTRUCTION PROGRESS SCHEDULES AND REPORTS: continued

2.04 CONSTRUCTION PROGRESS SCHEDULE (GANTT CHART):

- A. Gantt-Chart Schedule: After submittal of preliminary construction progress schedule as stated above, submit a detailed construction progress schedule within 30 days after the Notice to Proceed. Base the schedule on the preliminary construction progress schedule and incorporate review comments and other feedback.
- B. The schedule shall show the Work in a horizontal bar chart or other graphic format suitable for displaying scheduled and actual progress.
 - 1. The schedule shall indicate phases of the Work, starting date, interim milestones, and dates of Substantial Completion and Final Completion.
 - 2. Breakdown Work phases into separate time bar for each significant construction activity entry, with dates Work is expected to begin and be completed. Within each time bar, indicate estimated completion percentage in 10% increments.
 - 3. Scale and spacing shall allow room for notation and revisions.
 - 4. Sheet Size: Minimum 11 x 17 inches.
- C. Provide subschedules to define in more detail critical portions of schedules, including inspections and tests.
- D. Coordinate construction progress schedule with schedule of values, schedule of Submittals schedule, procurement schedule, progress reports, and payment requests.
- E. Engineer will review and comment on construction progress schedule and, upon agreement between Engineer and Contractor on necessary changes:
 - 1. Contractor shall distribute copies as specified of the accepted "baseline" schedule to Engineer. Contractor shall provide additional copies to Subcontractors and other parties required to comply with scheduled dates, one copy to each party.
- F. Revise the construction progress schedule after each meeting, event, or activity where revisions have been recognized and accepted to reflect impacts of new developments on the schedule.
- G. Update and submit six copies to Engineer of the revised schedule at least once each month to show actual progress compared to the originally accepted "baseline" schedule and any proposed changes in the schedule of remaining Work. Include with construction progress report and submit with monthly application for payments.

2.05 SCHEDULE OF VALUES:

- A. Based on the preliminary draft schedule of values, reviewed by Engineer [and Owner], submit finalized schedule of values acceptable to Engineer as to form and basic details. Submit final within 30 days after Notice to Proceed.
- B. Coordinate preparation of schedule of values with preparation and content of construction progress schedule.
- C. Content:
 - 1. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
 - 2. Follow the construction progress schedule breakdown of Work activities as format for listing component items and assigning values.
 - 3. For each major line item, list subvalues of major products or operations under the item.
 - a. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - b. For items on which progress payments will be requested for stored materials received, but not installed, break down the value into:
 - (1) The cost of the materials, delivered and unloaded, including taxes paid unless taxes are exempted.

SECTION 01 32 00 – CONSTRUCTION PROGRESS SCHEDULES AND REPORTS: continued

- (2) The total installed value.
- c. The sum of all values listed in the schedule shall equal the total Contract Price.
- d. Schedule of Estimated Monthly Applications for Progress Payments:
 - (1) Based on Preliminary schedule of estimated monthly applications for progress payments, revise based on finalized schedule of values.
 - (2) Reverse and submit updated schedule of monthly application for payment throughout the entire duration of Project.

2.06 REPORTS:

- A. Construction Progress Reports:
 - 1. Submit a report on actual construction progress on a monthly basis. More frequent reports may be required should the Work fall behind the accepted schedule.
 - a. Submit a weekly report and three-week look-ahead schedule to coordinate with and supplement the monthly construction progress report and which details Work scheduled for the following one-week interval, including:
 - (1) Work activities which will occur.
 - (2) Number and size of crews.
 - (3) Construction equipment on Site.
 - (4) Major items of Equipment and Material to be installed.
 - b. Format shall be on 11 x 17-inch paper, submitted to Engineer in 3 copies.
 - 2. Construction progress reports shall consist of the revised construction progress schedule and a narrative report which shall include but not be limited to the following:
 - a. Comparison of actual progress to planned progress shown on originally accepted schedule.
 - b. Summary of activities completed since the previous construction progress report.
 - c. Summary of activities planned for next reporting period.
 - d. Identification of problem areas.
 - e. A description of current and anticipated delaying factors, if any.
 - f. Impact of possible delaying factors.
 - g. Proposed corrective actions.
 - 3. Submit a construction progress report to Engineer with each application for partial payment. Work reported complete but not readily apparent to Engineer must be substantiated with supporting data when requested by Engineer.
 - 4. If a schedule update reveals that, through no fault of Owner, the Work is likely to be completed later than the Contract completion date, Contractor shall:
 - a. Establish a plan for making up lost time.
 - (1) Increase number of workers, or
 - (2) Increase amount or kinds of tools, or
 - (3) Work overtime or additional shifts, or
 - (4) A combination of 2 or more of the above 3 actions.
 - b. Submit plan to Owner and Engineer before implementing the plan.
 - c. Take actions as necessary to get the Work back on schedule at no additional cost to Owner.
- B. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project Site:
 - 1. List of Subcontractors at Project Site.
 - 2. List of separate contractors at Project Site.
 - 3. Approximate count of personnel at Project Site, and breakdown by craft.
 - 4. Equipment at Project Site.

SECTION 01 32 00 – CONSTRUCTION PROGRESS SCHEDULES AND REPORTS: continued

5. Material deliveries.
 6. High and low temperatures and general weather conditions.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (refer to special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
- C. Equipment and Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of Equipment and Materials delivered to and stored at Project Site. List shall be cumulative, showing Equipment and Materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for Materials or items of Equipment fabricated or stored away from Project Site.
- D. Field Condition Reports: Promptly on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for information (RFI). Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- E. Special Reports:
1. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
 2. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project Site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION - NOT APPLICABLE

END OF SECTION 01 32 00

SECTION 01 32 33 – CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies administrative and procedural requirements for construction photographs.

1.02 SUBMITTALS:

- A. Submit prints as specified in Section 01 33 00 – "Submittals" and in PART 3 - this Section.
- B. Photographer shall submit two sample prints of the type and quality required during construction, for review and acceptance by Engineer.

1.03 QUALITY ASSURANCE:

- A. All photographs shall be taken and processed by a qualified and established commercial photographer experienced in construction photography.

PART 2 - PRODUCTS

2.01 PHOTOGRAPHIC REQUIREMENTS: SPECIFIED IN PART 3, THIS SECTION.

PART 3 - EXECUTION

3.01 PROGRESS SITE PHOTOGRAPHS:

- A. Contractor shall be responsible for photographs of the Site to show the existing and general progress of the Work. Engineer will advise as to which views are of interest. Photographs shall be taken of the following areas and at the following times.
 - 1. Existing Site conditions before Site work is started. Number of views shall be adequate to cover the Site.
 - 2. Progress of the Work from mobilization through construction. There shall be ten different views taken on or about the first of each month.
 - 3. Finished Project after completion of Work. Number of views shall be adequate to show the finished Work.
 - 4. If Project is not completed during the Contract Time or authorized extensions, photographs shall continue to be taken at no increase in Contract Price.
- B. Photographic Prints:
 - 1. All prints shall be color, smooth glossy finish, 4" x 6" in size taken with full frame 35 mm camera, and inserted into archival quality polypropylene photographic binder pages punched for insertion into a standard three-ring binder. Identify each album or binder by Contract name and Contract number.
- C. Digital Images:
 - 1. Submit a complete set of digital image electronic files with each submittal of photographic prints. Digital images shall be provided on PC-formatted CD-ROM. Digital images shall be in uncompressed JPEG filter format. A proof sheet containing all digital images with individual file names appearing adjacent to each respective image shall be provided with each submittal and shall be included on the respective CD-ROM where the digital file is stored.
 - a. Provide images in uncompressed JPEG format, with minimum sensor size of 4.0 megapixels.
 - b. Provide image resolution of not less than 2400 by 3200 pixels.
 - c. Submit images that have same aspect ratio as the sensor, uncropped.

SECTION 01 32 33 – CONSTRUCTION PHOTOGRAPHS: continued

2. Ownership of digital images: All digital images shall become property of Owner.
- D. Print Negatives:
 1. Negatives, if applicable, for 4” x 6” prints shall be protected by roll in negative sleeves. Negative sleeves shall be identified with Contract name and Contract number, date of exposure, roll number or other general identifying information, and name of Contractor.
- E. Identification:
 1. Identify each photographic print on the reverse side with a label which contains the Contract name and Contract number, date of exposure, and description of view. Prints shall also bear the photographer's name or trademark.
 2. All descriptive project information included within paragraph 3.01.E.1 shall be incorporated with each digital image. A unique and individual file name or number shall appear with this descriptive information, along with the respective number from the original film.
 - a. Descriptive information shall be removable from digital image file.
- F. Provide three prints of each view.
- G. Deliver prints, electronic media files, and photographic negatives to Engineer.

Burns & McDonnell Engineering Co.
Attn: Dana Bruner
9400 Ward Parkway
Kansas City, MO 64114

3.02 AUDIO/VIDEO TAPE RECORDINGS:

- A. Audio/video recordings are not required. If the Contractor chooses to use audio/visual recordings, a copy shall be provided to the Owner.

3.03 ADDITIONAL PHOTOGRAPHS:

- A. From time to time Engineer may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order, and are not included in the Contract Price or an Allowance.
 1. Engineer will give the photographer three days' notice, where feasible.
 2. In emergency situations, the photographer shall take additional photographs within 24 hours of Engineer's request.
 3. Circumstances that could require additional photographs include, but are not limited to:
 - a. Substantial Completion of a major phase or component of Work.
 - b. Owner's request for special publicity photographs.
 - c. Special events planned at Project Site.
 - d. Immediate follow-up when on-site events result in construction damage or losses.
 - e. Photographs to be taken at fabrication locations away from Project Site.
 - f. Extra record photographs at time of final acceptance.

END OF SECTION 01 32 33

SECTION 01 33 00 – SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes definitions, descriptions, transmittal, and review of Submittals.

1.02 RELATED REQUIREMENTS:

- A. Section 01 31 00 – "Construction Progress Schedules and Reports."
- B. Section 01 32 16 – "Project Coordination Meetings."
- C. Section 01 32 33 – "Construction Photographs."
- D. Section 01 78 00 – "Contract Closeout."

1.03 GENERAL INFORMATION:

A. Definitions:

1. Shop Drawings, product data, and Samples are technical Submittals prepared by Contractor, Subcontractor, manufacturer, or Supplier and submitted by Contractor to Engineer as a basis for approval of the use of Equipment and Materials proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties, as specified in each Division of the Specifications.
 - a. Shop Drawings include custom-prepared data of all types including drawings, diagrams, performance curves, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.
 - b. Product data includes standard printed information on materials, products, and systems; not custom-prepared for this Project, other than the designation of selections from available choices.
 - c. Samples include both fabricated and unfabricated physical examples of materials, products, and Work; both as complete units and as smaller portions of units of Work; either for limited visual inspection or (where indicated) for more detailed testing and analysis. Mock-ups are a special form of Samples which are too large to be handled in the specified manner for transmittal of Sample Submittals.
2. Informational Submittals are those technical reports, administrative Submittals, certificates, and guarantees not defined as Shop Drawings, product data, or Samples.
 - a. Technical reports include laboratory reports, tests, technical procedures, technical records, and Contractor's design analysis.
 - b. Administrative Submittals are those nontechnical Submittals required by the Contract Documents or deemed necessary for administrative records. These Submittals include maintenance agreements, Bonds, Project photographs, physical work records, statements of applicability, copies of industry standards, Project record data, schedules, security/protection/safety data, and similar type Submittals.
 - c. Certificates and guarantees are those Submittals on Equipment and Materials where a written certificate or guarantee from the manufacturer or Supplier is called for in the Specifications.
3. Refer to ARTICLES 1.03 and 1.04 of this Part for detailed lists of Submittals and specific requirements.

B. Quality Requirements:

1. Submittals such as Shop Drawings and product data shall be of suitable quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible. Drawings such as reproducibles shall be useable for further reproduction to yield legible hard copy. Partial resubmittals shall be rejected by the Engineer and returned to

SECTION 01 33 00 – SUBMITTALS: continued

the Contractor. All documents, drawings, pages, etc. contained in the original Submittal shall be contained in all subsequent Submittals.

2. Documents submitted to Engineer that do not conform to specified requirements shall be subject to rejection by Engineer, and upon request by Engineer, Contractor shall resubmit conforming documents. If conforming Submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Contractor's or his Subcontractor's failure to initially satisfy the legibility quality requirements will not relieve Contractor or his Subcontractors from meeting the required schedule for Submittals.
- C. Language and Dimensions:
1. All words and dimensional units shall be in the English language.
 2. Metric dimensional unit equivalents may be stated in addition to the English units. However, English units of measurement shall prevail.
- D. Submittal Completeness:
1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Engineer to review the information effectively.
 2. Where standard drawings are furnished which cover a number of variations of the general class of Equipment, each drawing shall be annotated to indicate exactly which parts of the drawing apply to the Equipment being furnished. Use hatch marks to indicate variations that do not apply to the Submittal. The use of "highlighting markers" will not be an acceptable means of annotating Submittals. Annotation shall also include proper identification of the Submittal permanently attached to the drawing.
 3. Reproductions or copies of Contract Drawings or portions thereof will not be accepted as complete fabrication or erection drawings. Contractor may use a reproduction of Contract Drawings for erection drawings to indicate information on erection or to identify detail drawing references. Whenever the Drawings are revised to show this additional Contractor information, Engineer's title block shall be replaced with Contractor's title block, and Engineer's professional seal shall be removed from the drawing. Contractor shall revise these erection drawings for subsequent Engineer revisions to the Contract Drawings.
- E. Form of Submittals:
1. Submittals and other Project documents shall be transmitted in paper copies in addition to electronic format as specified.
 - a. Submittals, instruction books, and operating manuals shall be provided in paper ("hardcopy") copies as well as in electronic format using procedures specified herein.
 - b. Equipment instruction books and operating manuals shall be provided in paper copies in addition to specified electronic format.
 2. Electronic Format:
 - a. Scanned Submittals and documents are not acceptable. Transmit Submittals and Project documents in:
 - (1) Nonproprietary, native electronic format incorporating any necessary reference files, or
 - (2) Adobe *PDF files created directly from native electronic format, or
 - (3) Engineer-approved equal.
 - b. For any given Submittal, the filename and format shall be consistent for initial submission and subsequent revisions of the same. Use consistent naming convention throughout.

SECTION 01 33 00 – SUBMITTALS: continued

- (1) Nonconforming Submittals are subject to rejection by Engineer.
- c. Provide "as-constructed" Submittals, record documents, Equipment instruction books and operating manuals, and other documents on CD-ROM in Adobe *PDF format as required and approved by Owner.
- d. Equipment instruction books and operating and maintenance manuals shall be in Adobe *PDF format combined in one pdf file for the complete O&M manual, or divided into pdf files that represent entire volumes corresponding to hardcopy volumes. The pdf files shall be completely bookmarked with links within the index sheet to the different sections within the manuals/volumes, corresponding to the defined tabs within the hardcopy version.
 - (1) Digital delivery media shall be Engineer's Managed File Transfer System (Accellion).

1.04 TECHNICAL SUBMITTALS:

- A. Items shall include, but not be limited to, the following:
 - 1. Manufacturer's specifications.
 - 2. Catalogs, or parts thereof, of manufactured Equipment.
 - 3. Shop fabrication and erection drawings.
 - 4. General outline drawings of Equipment showing overall dimensions, location of major components, weights, and location of required building openings and floor plates.
 - 5. Detailed Equipment installation drawings, showing foundation details, anchor bolt sizes and locations, baseplate sizes, location of Owner's connections; and all clearances required for erection, operation, and disassembly for maintenance.
 - 6. Schematic diagrams for electrical items, showing external connections, terminal block numbers, internal wiring diagrams and one-line diagrams.
 - 7. Bills of material and spare parts list.
 - 8. Instruction books and operating manuals.
 - 9. Material lists or schedules.
 - 10. Performance tests on Equipment by manufacturers.
 - 11. Concrete mix design information.
 - 12. Samples and color charts.
 - 13. All drawings, catalogs or parts thereof, manufacturer's specifications and data, Samples, instructions, and other information specified or necessary:
 - a. For Engineer to determine that Equipment and Materials conform to the design concept and comply with intent of the Contract Documents.
 - b. For proper erection, installation, operation, and maintenance of Equipment and Materials which Engineer will review for general content but not for basic details.
 - c. For Engineer to determine what supports, anchorages, structural details, connections, and services are required for Equipment and Materials, and effects on contiguous or related structures and Equipment and Materials.
- B. Schedule of Submittals:
 - 1. In establishing schedule for Submittals, allow 20 days in Engineer's office for reviewing original Submittals and 15 days in Engineer's office for reviewing resubmittals.
 - 2. Submittals requiring revision shall be resubmitted within 15 days after receipt of Engineer's review notations.
 - 3. The schedule shall indicate the anticipated dates of original submission for each item and Engineer's approval thereof, and shall be based upon at least one resubmission of each item.

SECTION 01 33 00 – SUBMITTALS: continued

4. Schedule all Submittals (Shop Drawings, product data, and Samples) required prior to fabrication or manufacture for submission within 120 days of the Notice to Proceed. Schedule Submittals pertaining to storage, installation, and operation at the Site for Engineer's approval prior to delivery of the Equipment and Materials.
 5. Resubmit Submittals the number of times required for Engineer's "Submittal Approved." However, any need for resubmittals in excess of the number set forth in the accepted schedule, or any other delay in obtaining approval of Submittals, will not be grounds for extension of the Contract Times, provided Engineer completes his reviews within the times specified.
 6. Where a Submittal is required by the Contract Documents or the accepted schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertaining Submittal will be at the sole expense and responsibility of Contractor.
- C. Transmittal of Submittals:
1. All Submittals (Shop Drawings, product data, and Samples) for Equipment and Materials furnished by Contractor, Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor.
 2. After checking and verifying all field measurements, transmit all Submittals to Engineer for approval as follows:
 - a. Submittal Information Block:
 - (1) Affix to all paper copies whether Submittal is prepared by Contractor, Subcontractor, or Supplier. Use transparent decal type Submittal Information Blocks for Shop Drawings and use gummed paper type for product data and Sample Submittals. All Submittal Information Blocks needed for this Contract will be furnished to Contractor at no charge at the initial coordination conference.
 - (2) An example of the Submittal Information Block is included as an appendix to this Section and can be provided to the Contractor in electronic format.
 - b. Mark each Submittal by Project name and number, Contract title and number, and applicable Specification Section and Article number. Include in the letter of transmittal the Drawing number and title, sheet number (if applicable), revision number, and electronic filename (if applicable). Unidentifiable Submittals will be returned for proper identification.
 - c. Check and approve Submittals of Subcontractors, Suppliers, and manufacturers prior to transmitting them to Engineer. Contractor's submission shall constitute a representation to Owner and Engineer that Contractor approves Submittals and has determined and verified all design criteria, quantities, dimensions, field construction and installation criteria, materials, catalog numbers, compliance with Laws and Regulations, and similar data, and Contractor assumes full responsibility for doing so; and Contractor has coordinated each Submittal with the requirements of the Work and the Contract Documents.
 - d. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from requirements of the Contract Documents.
 - e. Make all modifications noted or indicated by Engineer and return the required number of revised Submittals until approved. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by Engineer on previous Submittals. After paper copy Submittals have been approved, submit copies thereof for final distribution. Previously approved Submittals transmitted for final distribution will not be further reviewed and are not to be

SECTION 01 33 00 – SUBMITTALS: continued

- revised. If errors are discovered during manufacture or fabrication, correct the Submittal and resubmit for review.
- f. Following completion of the Work and prior to final payment, furnish record documents and approved Samples and Shop Drawings necessary to indicate "as constructed" conditions, including field modifications, in the number of copies specified. Furnish additional copies for insertion in Equipment instruction books and operating manuals as required. All such copies shall be clearly marked "PROJECT RECORD."
 - (1) Submit a final record copy of the Master Field Drawing list which shall indicate the final revision status of each drawing on the list.
 - g. Keep a copy or sample of each Submittal in good order at the Site.
3. Quantity Requirements:
- a. Except as otherwise specified, transmit all Shop Drawings in the following quantities:
 - (1) Initial Submittal:
 - (a) Paper – One copy to Engineer. One copy will be returned to Owner.
 - (b) Electronic – One copy to Engineer.
 - (2) Resubmittals:
 - (a) Paper – One copy to Engineer. One copy will be returned to Owner.
 - (b) Electronic – One copy to Engineer.
 - (3) Submittal for final distribution:
 - (a) Paper – Three copies plus the number of copies required by Contractor, to Engineer.
 - (b) Electronic - One copy to Engineer.
 - b. Transmit Submittals of product data as follows:
 - (1) Initial Submittal:
 - (a) Paper– One copy to Engineer. One copy will be returned to Owner.
 - (b) Electronic – One copy to Engineer.
 - (2) Resubmittals:
 - (a) Paper – One copy to Engineer. One copy will be returned to Owner.
 - (b) Electronic - One copy to Engineer.
 - (3) Submittal for final distribution:
 - (a) Paper – Three copies plus the number of copies required by Contractor, to Engineer.
 - (b) Electronic - One copy to Engineer.
 - c. Transmit Submittals of Material Samples, color charts, and similar items as follows:
 - (1) Initial Submittal – Four to Engineer.
 - (2) Resubmittal – Four to Engineer.
 - (3) Upon approval, Two Samples will be returned to Contractor.
 - d. Transmit Submittals of Equipment instruction books and operating manuals as follows:
 - (1) Initial Submittal:
 - (a) Paper – One copy to Engineer. One copy will be returned to Owner.
 - (b) Electronic - One copy to Engineer.
 - (2) Resubmittals:
 - (a) Paper – One copy to Engineer. One copy will be returned to Owner.
 - (b) Electronic - One copy to Engineer.
 - (3) Submittal for Final Distribution – Three paper copies and two electronic copies to Engineer.

SECTION 01 33 00 – SUBMITTALS: continued

- e. Owner may copy and use for internal operations and staff training purposes any and all document Submittals required by this Contract and approved for final distribution, whether or not such documents are copyrighted, at no additional cost to Owner. If permission to copy any such Submittal for the purposes stated is unreasonably withheld from Owner by Contractor or any Subcontractor, manufacturer, or Supplier, Contractor shall provide to Engineer 20 copies plus the number of copies required by Contractor at each final distribution issue.
- D. Engineer's Review:
1. Engineer will review and take appropriate action on Submittals in accordance with the accepted schedule of Submittals. Engineer's review and approval will be only to determine if the items of Equipment and Materials covered by the Submittals will, after installation or incorporation in the Work, conform to information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to design data reflected in Submittals which is peculiarly within the special expertise of Contractor or Contractor's Subcontractors or Suppliers. Review and approval of a component item as such will not indicate approval of the assembly in which the item functions.
 3. Engineer's review and approval of Shop Drawings, product data, or Samples will not relieve Contractor of responsibility for any deviation from requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission, and Engineer has given written concurrence in and approval of the specific deviation. Approval by Engineer shall not relieve Contractor from responsibility for errors or omissions in Submittals.
 4. Reference GENERAL CONDITIONS regarding excess submittal review.
- E. Submittal Action Stamp:
1. Engineer's review action stamp, appropriately completed, will appear on all Submittals of Contractor when returned by Engineer. Review status designations listed on Engineer's action stamp are defined as follows:

A - SUBMITTAL APPROVED: Signifies Equipment or Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work. Contractor is to proceed with fabrication or procurement of the items and with related Work. Copies of the Submittal are to be transmitted to Engineer for final distribution.

B - SUBMITTAL APPROVED AS NOTED (RESUBMIT): Signifies Equipment and Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work in accordance with Engineer's notations. Contractor is to proceed with fabrication or procurement of the items and with related Work in accordance with Engineer's notations and is to submit a revised Submittal responsive to notations marked on the returned Submittal or written in the letter of transmittal.

C - SUBMITTAL RETURNED FOR REVISION (RESUBMIT): Signifies Equipment and Material represented by the Submittal appears to conform with the design concept and comply with the intent of the Contract Documents but information is either insufficient in detail or contains discrepancies which prevent Engineer from completing his review. Contractor is to resubmit revised information responsive to Engineer's annotations

SECTION 01 33 00 – SUBMITTALS: continued

on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related Work is not to proceed until the Submittal is approved.

D - SUBMITTAL NOT APPROVED (SUBMIT ANEW): Signifies Equipment and Material represented by the Submittal does not conform with the design concept or comply with the intent of the Contract Documents and is disapproved for use in the Work. Contractor is to provide Submittals responsive to the Contract Documents.

E - PRELIMINARY SUBMITTAL: Signifies Submittals of such preliminary nature that a determination of conformance with the design concept or compliance with the intent of the Contract Documents must be deferred until additional information is furnished. Contractor is to submit such additional information to permit layout and related activities to proceed.

F - FOR REFERENCE, NO APPROVAL REQUIRED: Signifies Submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins and similar data, all of which are useful to Engineer or Owner in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the intent of the Contract Documents. Engineer reviews such Submittals for general content but not for basic details.

G - DISTRIBUTION COPY (PREVIOUSLY APPROVED): Signifies Submittals which have been previously approved and are being distributed to Contractor, Owner, Resident Project Representative, and others for coordination and construction purposes.

F. Instruction Books and Operating Manuals:

1. In addition to electronic Submittals specified above, equipment instruction books and operating manuals prepared by the manufacturer shall include the following:
 - a. Index and tabs.
 - b. Instructions for installation, start-up, operation, inspection, maintenance, parts lists and recommended spare parts, and data sheets showing model numbers.
 - c. Applicable drawings.
 - d. Warranties and guarantees.
 - e. Address of nearest manufacturer-authorized service facility.
 - f. All additional data specified.
2. Information listed above shall be bound into hard-back binders of the “D”-type ring not filled more than 75%. Sheet size shall be 8-1/2 x 11. Binder color shall be black. Capacity shall be a minimum of 1-1/2 inches, but sufficient to contain and use sheets with ease.
 - a. Provide the following accessories:
 - (1) Label holder.
 - (2) Business card holder.
 - (3) Sheetlifters.
 - (4) Horizontal pockets.
 - b. The following information shall be imprinted, inserted, or affixed by label on the binder front cover and in the CD-ROM disk and jewel cases:
 - (1) Owner's name.

SECTION 01 33 00 – SUBMITTALS: continued

- (2) Owner's facility or plant name.
 - (3) Equipment item name.
 - (4) Volume number (if applicable).
 - (5) Contract number.
 - (6) Manufacturer's name and address.
 - c. The following information shall be imprinted, inserted, or affixed by label on the binder spine:
 - (1) Equipment item name.
 - (2) Owner's name and Owner's facility or plant name.
 - (3) Manufacturer's name.
 - (4) Contract number.
 - (5) Volume number (if applicable).
 - d. Submit mockup of cover and spine, CD-ROM jewel case cover and spine, and CD-ROM label for Engineer's review and approval.
 - (1) Preliminary and/or subsequent resubmittals shall not be given "A-SUBMITTAL APPROVED" action until mockup has been submitted and approved.
 - (2) Final distribution copies which do not conform to these specifications shall be rejected and returned to the Contractor.
- G. Samples:
- 1. Office Samples shall be of sufficient size and quantity to clearly illustrate the following:
 - a. Functional characteristics of the product, with integrally related parts and attachment devices.
 - b. Full range of color, texture, and pattern.
 - c. Material, manufacturer, pertinent catalog number, and intended use.

1.05 INFORMATIONAL SUBMITTALS:

- A. Informational Submittals are comprised of technical reports, administrative Submittals, and guarantees which relate to the Work, but do not require Engineer approval prior to proceeding with the Work. Informational Submittals include:
- 1. Welder qualification tests.
 - 2. Welding procedure qualification tests.
 - 3. X-ray and radiographic reports.
 - 4. Hydrostatic testing of pipes.
 - 5. Field test reports.
 - 6. Concrete cylinder test reports.
 - 7. ASME pressure vessel test reports.
 - 8. Certification on Materials:
 - a. Steel mill tests.
 - b. Roofing laboratory tests.
 - c. Brick and concrete masonry unit laboratory tests.
 - d. Paint laboratory tests.
 - e. Metal paneling laboratory tests.
 - f. Cement tests.
 - 9. Soil test reports.
 - 10. Air handling balancing reports.
 - 11. Temperature records.
 - 12. Piping stress analysis.
 - 13. Shipping or packing lists.

SECTION 01 33 00 – SUBMITTALS: continued

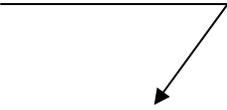
14. Job progress schedules.
 15. Equipment and Material delivery schedules.
 16. Progress photographs.
 17. Warranties and guarantees.
 18. Fire protection and hydraulic calculations.
- B. Transmittal of Informational Submittals:
1. All informational Submittals furnished by Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor unless otherwise specified.
 - a. Identify each informational Submittal by Project name and number, Contract title and number, and Specification Section and Article number marked thereon or in letter of transmittal. Unidentifiable Submittals will be returned for proper identification.
 - b. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from requirements of the Contract Documents.
 2. Quantity Requirements:
 - a. Technical reports and administrative Submittals except as otherwise specified:
 - (1) Paper: Two copies to Engineer.
 - (2) Electronic: One to Engineer.
 - b. Written Certificates and Guarantees:
 - (1) Engineer: Four copies.
 3. Test Reports:
 - a. Responsibilities of Contractor, Owner, and Engineer regarding tests and inspections of Equipment and Materials and completed Work are set forth elsewhere in these Contract Documents.
 - b. The party specified responsible for testing or inspection shall in each case, unless otherwise specified, arrange for the testing laboratory or reporting agency to distribute test reports as follows:
 - (1) Owner: Two copies.
 - (2) Engineer: Two copies.
 - (3) Resident Project Representative: One copy.
 - (4) Contractor: Two copies.
 - (5) Manufacturer or Supplier: One copy.
- C. Engineer's Review:
1. Engineer will review informational Submittals for indications of Work or Material deficiencies.
 2. Engineer will respond to Contractor on those informational Submittals which indicate Work or Material deficiency.

PART 2 - EXECUTION - NOT APPLICABLE.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 01 33 00

SUBMITTAL INFORMATION BLOCK

Contractor fills in all blanks
without preprinted information 

| | | | | | | | | | | | |
|--|---|-----------------|-----------------|---------|---------|---------|---------|---------|---------|---------|--|
| <p>Project and Contract Identification</p> <p>Contractor _____</p> <p>Project Name _____</p> <p>Project Number _____</p> <p>Contract Title _____</p> <p>Contract No. _____</p> <p>Spec. Sect. No. _____ Art. No. _____</p> <p>Contractor's Approval: Submission of this document shall represent Contractor's approval as specified in the Contract Documents. Contractor remains liable for accuracy of Submittals as provided in the Contract Documents.</p> | <p>Date Engineer Received _____</p> <hr/> <p>Engineer's Action</p> <p>(See Contract Documents)</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; width: 50%;">Initials & Date</td> <td style="text-align: center; width: 50%;">Initials & Date</td> </tr> <tr> <td>A _____</td> <td>E _____</td> </tr> <tr> <td>B _____</td> <td>F _____</td> </tr> <tr> <td>C _____</td> <td>G _____</td> </tr> <tr> <td>D _____</td> <td></td> </tr> </table> | Initials & Date | Initials & Date | A _____ | E _____ | B _____ | F _____ | C _____ | G _____ | D _____ | |
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| C _____ | G _____ | | | | | | | | | | |
| D _____ | | | | | | | | | | | |

 For the use of Engineer

1. Use this Submittal Information Block on all Submittals, whether prepared by Contractor, Subcontractor, or Supplier. On Shop Drawings, place as near as possible to the title block in the lower right corner.

SECTION 01 40 00 – CONTRACTOR QA/QC

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.02 RELATED REQUIREMENTS:

- A. For developing a schedule of required tests and inspections: Section 01 32 00 – "Construction Progress Schedules and Reports."
- B. For repair and restoration of construction disturbed by testing and inspecting activities: Section 01 73 29 – "Cutting and Patching."
- C. For specific test and inspection requirements: DIVISIONS 02 through 46 sections.

1.03 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. ASTM International (ASTM):
 - 1. E548 - Guide for General Criteria Used for Evaluating Laboratory Competence.
- C. Code of Federal Regulations (CFR):
 - 1. 29 CFR 1910, Subpart A, Section 1910.7 - Definition and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

1.04 DEFINITIONS:

- A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual Equipment and Materials incorporated into the Work and completed construction comply with requirements. Services do not include Contract enforcement activities performed by Engineer or Owner.
- C. Mockups: Full-size, physical assemblies that are constructed on Site. Mockups are used to verify selections made under Sample Submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

SECTION 01 40 00 – CONTRACTOR QA/QC: continued

- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before Equipment and Materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality Control Testing: Tests and inspections that are performed on Site for installation of the Work and for completed Work, i.e., soil compaction, concrete strength, and weld radiographs.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.05 SUBMITTALS:

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality control service.
- C. Reports: Arrange for testing agency/laboratory to prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.

SECTION 01 40 00 – CONTRACTOR QA/QC: continued

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.06 QUALITY ASSURANCE:

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing Equipment or systems or Material similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing Equipment and Material similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, Equipment, or Material that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP).
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's Equipment, Material, or systems that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

SECTION 01 40 00 – CONTRACTOR QA/QC: continued

- c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build Site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer[, through Construction Manager], with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer.
 2. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 4. Obtain Engineer's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed, unless otherwise indicated.

1.07 QUALITY CONTROL:

- A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor[, and the Contract Price will be adjusted by Change Order].
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality control services. Testing agency shall be acceptable to Engineer and/or Owner.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

SECTION 01 40 00 – CONTRACTOR QA/QC: continued

3. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in 2 copies, of each quality control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services:
1. Where indicated or specified in respective Equipment specifications, provide services of an experienced, competent, factory-authorized representative of the manufacturer of each item of Equipment.
 2. Arrange for Field Services representative to visit the Site of the Work and inspect, check, adjust as necessary, and approve the Equipment installation, including service connections. Field Services representative shall be present when Equipment is started up and placed into operation, and shall revisit the Site as often as necessary until problems are corrected, and Equipment installation and operation are acceptable to Engineer and Owner.
 3. Submit to Engineer the Field Services representative's completed record forms as required and written report certifying that the Equipment has been properly installed and lubricated; is in accurate alignment; is free from undue stress imposed by connecting piping or anchor bolts; and has been successfully operated under expected full load conditions.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer, Owner and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

SECTION 01 40 00 – CONTRACTOR QA/QC: continued

7. Security and protection for samples and for testing and inspecting equipment at Project Site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Submit schedule within 30 days of date established in the Notice to Proceed.
 1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION

3.01 TEST AND INSPECTION LOG:

- A. Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project Site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.02 REPAIR AND PROTECTION:

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Section 0 17 31 – "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 – DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.01 SUMMARY:

A. Definitions:

1. Basic contract definitions used in the Contract Documents are defined in the GENERAL CONDITIONS. Definitions and explanations are not necessarily either complete or exclusive, but are general for the Work.
2. General Requirements are the provisions or requirements of DIVISION 01 Sections, and which apply to the entire Work of the Contract.

1.02 RELATED REQUIREMENTS:

- ##### A. Specification standards and associations applicable to the Work are specified in each Section.

1.03 SPECIFICATION FORMAT AND CONTENT EXPLANATIONS:

- ##### A. Specification Format: The Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's (CSI) Section Format and MasterFormat numbering system. Some portions may not fully comply and no particular significance will be attached to such compliance or noncompliance.

1. Divisions and Sections: For convenience, a basic unit of Specification text is a "Section," each unit of which is numbered and named. These are organized with related Sections, into "Divisions," which are recognized as the present industry consensus on uniform organization and sequencing of Specifications. The Section title is not intended to limit meaning or content of Section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of text.
2. Section Numbering: Used for identification and to facilitate cross-references in Contract Documents. Sections are placed in numeric sequence; however, numbering sequence is not complete, and listing of Sections in Table of Contents at beginning of the Project Manual must be consulted to determine numbers and names of Specification Sections in these Contract Documents.
3. Page Numbering: Numbered independently for each Section. Section number is shown with page number at bottom of each page, to facilitate location of text.
4. Parts: Each Section of Specifications generally has been subdivided into three basic "parts" for uniformity and convenience (PART 1 - GENERAL, PART 2 - PRODUCTS, and PART 3 - EXECUTION). These "Parts" do not limit the meaning of text within. Some Sections may not contain all three "Parts" when some are not applicable, or may contain more than three "Parts" to add clarity to organization of Section.
5. Underscoring of Titles: Used strictly to assist reader of Specification in scanning text for key words in content. No emphasis on or relative importance is intended except where underscoring may be used in body of text to emphasize a duty, critical requirement, or similar situation.
6. Project Identification: Project file number and identification are recorded at bottom of each page of Specifications to minimize possible misuse of Specifications, or confusion with other Project Specifications.

B. Specification Content:

1. These Specifications apply certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - a. Imperative and Streamlined Language: These Specifications are written in imperative and abbreviated form. This imperative language of the technical

SECTION 01 42 00 – DEFINITIONS AND STANDARDS: continued

Sections is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall," "the Contractor shall," and "shall be," and similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words "shall be" shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated imperatively or otherwise.

- b. **Specifying Methods:** The techniques or methods of specifying requirements varies throughout text, and may include "prescriptive," "compliance with standards," "performance," "proprietary," or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.
 - c. **Overlapping and Conflicting Requirements:** Where compliance with two or more industry standards or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, notify Engineer in writing for a decision, which Engineer will render in writing within a reasonable time.
 - d. **Abbreviations:** Throughout the Contract Documents are abbreviations implying words and meanings which shall be appropriately interpreted. Specific abbreviations have been established, principally for lengthy technical terminology and in conjunction with coordination of Specification requirements with notations on Drawings and in schedules. These are normally defined at first instance of use. Organizational and association names and titles of general standards are also abbreviated.
- C. **Assignment of Specialists:** In certain instances, Specification text requires that specific Work be assigned to specialists in the operations to be performed. These specialists shall be engaged for performance of those units of Work, and assignments are requirements over which Contractor has no choice or option. These assignments shall not be confused with, and are not intended to interfere with, enforcement of building codes and similar regulations governing the Work, local trade and union jurisdictions, and similar conventions. Nevertheless, final responsibility for fulfillment of Contract requirements remains with Contractor.
- D. **Trades:** Except as otherwise specified or indicated, the use of titles such as "carpentry" in Specification text, implies neither that the Work must be performed by an accredited or unionized tradesperson of corresponding generic name (such as "carpenter"), nor that specified requirements apply exclusively to work by tradespersons of that corresponding generic name.

1.04 DRAWING SYMBOLS:

- A. Except as otherwise indicated, graphic symbols used on Drawings are those symbols recognized in the construction industry for purposes indicated. Refer instances of uncertainty to Engineer for clarification.

1.05 INDUSTRY STANDARDS:

- A. **Applicability of Standards:** Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference and are stated in each Section.
 - 1. Referenced standards, referenced directly in Contract Documents or by governing regulations, have precedence over non-referenced standards which are recognized in industry for applicability to the Work.

SECTION 01 42 00 – DEFINITIONS AND STANDARDS: continued

2. Where compliance with an industry standard is required, the latest standard in effect at time of opening Bids shall govern.
 3. Where an applicable code or standard has been revised and reissued after the effective date of the Contract and before performance of Work affected by the revision, Engineer will decide whether to issue a Change Order to proceed with the revised standard.
 4. In every instance the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. Refer instances of uncertainty to Engineer for a decision before proceeding.
 5. Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - a. Where copies of standards are needed for performance of a required construction activity, Contractor shall obtain copies directly from the publication source.
- B. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 01 42 00

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes requirements of a temporary nature not normally incorporated into final Work. It includes the following:
 - 1. Utility services.
 - 2. Construction and support facilities.
 - 3. Construction aids.
 - 4. Safety and health.
 - 5. Fire protection.

1.02 RELATED REQUIREMENTS:

- A. Temporary Barriers and Controls: Section 01 57 00.
- B. Field Offices and Sheds: Section 01 52 00.

1.03 REFERENCE STANDARDS:

- A. American National Standards Association (ANSI):
 - 1. A10 Series - Safety Requirements for Construction and Demolition.
- B. National Electrical Contractors Association (NECA):
 - 1. Electrical Design Library - Temporary Electrical Facilities.
- C. National Fire Protection Association (NFPA):
 - 1. 10 - Portable Fire Extinguishers.
 - 2. 70 - National Electrical Code.
 - 3. 241 - Safeguarding Construction, Alterations, and Demolition Operations.
- D. National Electrical Manufacturers Association (NEMA).
- E. Underwriters Laboratories (UL).

1.04 SUBMITTALS:

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Submit a schedule indicating implementation and termination of each temporary utility within 15 days of the date established for commencement of the Work.

1.05 QUALITY ASSURANCE:

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:
 - 1. Building Code requirements.
 - 2. Health and safety regulations.
 - 3. Utility company regulations.
 - 4. Police, Fire Department, and rescue squad rules.
 - 5. Environmental protection regulations.
- B. Standards:
 - 1. Comply with NFPA 10 and 241, and ANSI A10 Series standards "Temporary Electrical Facilities."
 - 2. Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70.
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES: continued

1.06 PROJECT CONDITIONS:

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of the permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous, dangerous, unsanitary conditions, or public nuisances to develop or persist on the Site.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

- A. Provide new materials and equipment. If acceptable to Engineer, undamaged previously used materials and equipment in serviceable condition may be used. Provide materials and equipment suitable for the use intended, of capacity for required usage, and meeting applicable codes and standards. Comply with requirements of DIVISIONS 2 through 46.
- B. Water: Provide potable water approved by local health authorities.
- C. Water Hoses: Provide 3/4-inch (19-mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet (30 m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- D. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- E. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- F. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- G. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.
- H. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.01 TEMPORARY UTILITIES:

- A. General:
 - 1. Engage the appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES: continued

2. Provide adequate utility capacity at each stage of construction. Prior to availability of temporary utilities at the Site, provide trucked-in services as required for start-up of construction operations.
 3. Obtain and pay for temporary easements required to bring temporary utilities to the Project Site, where Owner's permanent easement cannot be used for that purpose.
 4. Furnish, install, and maintain temporary utilities required for adequate construction, safety, and security. Modify, relocate, and extend systems as Work progresses. Repair damage caused by installation or use of temporary facilities. Grade the areas of Site affected by temporary installations to required elevations and grades, and clean the area. Remove on completion of Work or until service or facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
 5. The types of temporary construction utilities and facilities required include, but not by way of limitation, water distribution, drainage, dewatering equipment, enclosure of Work, heat, ventilation, electrical power distribution, lighting, hoisting facilities, stairs, ladders, and roads.
 6. Inspect and test each service before placing temporary utilities in use. Arrange for required inspections and tests by governing authorities, and obtain required certifications and permits for use.
 7. Materials used for temporary service shall not be used in the permanent system unless so specified or acceptable to Engineer.
- B. Because of operational requirements, Owner may restrict or curtail Contractor's use of electric power and water. If these utilities are critical to Contractor's operations and completion of the Contract on the agreed schedule, Contractor shall consider furnishing alternate sources for its own use. Restriction or curtailment of these utilities shall not be a basis for a claim against Owner or an extension of the agreed schedule.

3.02 TEMPORARY ELECTRICITY AND LIGHTING:

- A. Use of Existing System:
1. Owner's existing system may be used for temporary electricity.
 2. Provide connections to existing facilities, size to provide service required for power and lighting.
 3. Power Source: Make connections to Owner's service, located at point indicated or instructed by Owner.
 4. Modify, supplement, and extend service as necessary to meet needed requirements and prevent overloading of existing system.
 5. Protect system to prevent interference with Owner's normal usage.
- B. Use of Permanent System:
1. Use of permanent system shall not be used for construction purposes.
- C. Costs of Installation and Operation:
1. Pay fees and charges for permits and applications.
 2. Pay costs of installation, maintenance, removal of temporary services, and restoration of any permanent facilities used.
 3. Pay costs of electrical power used.

3.03 TEMPORARY HEAT AND VENTILATION:

- A. General:
1. Provide temporary heat, ventilation, and cooling as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES: continued

- damage. Protect from adverse affects of low temperatures or high humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
 - 2. Methods of heating and fuel shall be suitable for particular purposes. Portable heaters shall be standard approved units with controls.
 - B. Use of Existing Systems:
 - 1. Existing systems shall not be used for temporary heating, cooling, or ventilating.
 - C. Use of Permanent System:
 - 1. Prior to use of permanent system, obtain written permission of Owner, which will define:
 - a. Conditions of use.
 - b. Provisions relating to guarantees on equipment.
 - 2. Prior to operation, verify that inspection has been made by proper authorities and installation has been approved for operation.
 - 3. Install temporary filters for air-handling units and for permanent ducts. Install new filters upon Substantial Completion.
 - 4. Provide operation and maintenance of systems.
 - 5. Place operational zones of permanent HVAC system in use sequentially as respective areas of Project become adequately enclosed for efficient operation.
 - 6. Contractor shall send copies of all correspondence with Owner regarding use of permanent sytem to Engineer prior to use of permanent system.
 - D. Costs of Installation and Operation:
 - 1. Pay fees and charges for applications, permits, and inspections.
 - 2. Pay costs of installation, operation, maintenance, removal of equipment, and restoration of existing or permanent facilities if used.
 - 3. Pay cost of power and fuel used.
- 3.04 TEMPORARY WATER:
- A. Use of Existing System:
 - 1. Owner's existing system may be used for temporary water.
 - a. Contractor shall comply with Owner's requirements including, but not limited to, withdrawal rate, withdrawal time, and duration. Owner may restrict days of the week and times when water may be available for construction purposes based on system demands and other factors.
 - b. Owner will provide all water for completion of the work and for flushing, testing, and disinfection.
 - (1) Owner will provide water for initial flushing, testing, and disinfection. If initial test and or disinfection fails to pass test as specified, water used for reflushing, retesting, and/or redisinfection shall be furnished at expense of the Contractor.
 - 2. Make connections to existing facilities to provide water for construction purposes.
 - a. Water Source: Make connections to Owner's service located at point indicated or where instructed by Owner.
 - 3. Modify, supplement, and extend system as necessary to meet temporary water requirements and prevent overloading of existing system.
 - 4. Regulate system to prevent interference with Owner's usage.
 - B. Use of Permanent System:
 - 1. Prior to use of permanent system for construction purposes, obtain written permission of Owner.
 - 2. Prior to Use of System for Drinking Water:
 - a. Disinfect piping.

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES: continued

- b. Obtain inspection and approval of governing authority.
 - C. Costs of Installation and Operation:
 - 1. Pay all costs for installation, maintenance, and removal.
 - 2. Cost of water used will be paid by Owner.

- 3.05 TEMPORARY TELEPHONE, INTERNET AND EMAIL SERVICE:
 - A. General:
 - 1. Arrange with local cellular/mobile telephone service company and provide mobile telephone service for use by Contractor and so Contractor can be reached at construction Site during normal working hours.
 - B. Costs of Installation and Operation:
 - 1. Pay all costs for installation, maintenance and removal, and service charges for local calls, internet services, internet access, and emails. Toll charges shall be paid by the party who places the call.

- 3.06 TEMPORARY GAS:
 - A. New Service:
 - 1. Arrange with utility company provide service required for natural gas requirements.
 - 2. Connect service in a manner directed by utility company officials. Provide separate meter and shutoff valve near connection to main gas line.
 - 3. The gas service shall be of sufficient capacity for the various construction service and systems required.
 - 4. Install all necessary piping and fittings so that gas is available to area needed. Protect piping and fittings from damage and leakage.
 - B. Use of Existing System:
 - 1. Owner's existing system shall not be used for temporary gas.
 - C. Costs of Installation and Operation:
 - 1. Pay all costs for installation, maintenance, and removal.
 - 2. Pay costs of gas used.

- 3.07 TEMPORARY SANITARY FACILITIES:
 - A. Contractor-Furnished Facilities:
 - 1. Furnish, install, and maintain temporary sanitary facilities for use through construction period. Remove on completion of Work.
 - 2. Provide for all construction workers under this Contract and representatives at the Site.
 - 3. Toilet facilities shall be of the chemical, aerated recirculation, or combustion type, properly vented, and fully enclosed with a glass- fiber-reinforced polyester shell or similar nonabsorbent material.
 - 4. Water and sewer connected facilities may be installed to extent permitted by governing regulations.
 - a. Provide lavatories, mirrors, urinals (where applicable), and water closets in water and sewer connected units. Provide only potable water at lavatories. Provide individual compartments for water closets where the unit is intended for occupancy by more than one person. Provide suitable enclosure with nonabsorbent sanitary finish materials and adequate heat, ventilation, and lighting.
 - b. Provide separate toilet facilities for male and female construction personnel as required.
 - 5. Wash Facilities: Install potable water-supplied wash facilities at locations convenient to construction personnel involved in the handling of compounds and materials where

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES: continued

wash-up is necessary to maintain a safe, healthy and sanitary condition. Where recommended or required by governing authorities and regulations or recognized standards provide emergency safety showers, emergency eye-wash fountains, showers, and similar facilities. Dispose of drainage properly. Supply soap and other cleaning compounds appropriate for each condition.

6. Drinking Water Fixtures: Provide containerized tap-dispenser type drinking water units.
 7. Supply and maintain toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each facility. Provide appropriate covered waste containers for used material.
- B. Use of Existing Facilities:
1. Existing restrooms facilities shall not be used.
- C. Use of Permanent Facilities:
1. Permanent sanitary facilities shall not be used by construction personnel.

3.08 SEWERS AND DRAINAGE:

- A. General: Where sewers or drainage facilities are not available for discharge of effluent, provide containers to remove and dispose of effluent off the Site in a lawful manner. If existing sewers are available for temporary drainage near the Site prior to completion of permanent sewers, provide temporary connections to remove effluent that can be lawfully discharged into the sewers. If existing sewers cannot be used for discharge, provide drainage ditches, dry wells, waste stabilization ponds, and similar discharge facilities to remove effluent that can be lawfully discharged in that manner.
- B. Connect temporary sewers to the municipal sewer systems in the manner directed by the sewer department officials.
- C. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy usage, restore to normal conditions promptly. Provide and maintain temporary earthen embankments and similar barriers in and around construction excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rain storms.

3.09 TEMPORARY CONSTRUCTION AIDS:

- A. General:
1. Provide construction aids and equipment required by personnel and to facilitate the execution of the Work; scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes, and other such facilities and equipment.
 2. Materials may be new or used, must be suitable for the intended purpose, and meet the requirements of applicable codes, regulations, and standards.
 3. When permanent stair framing is in place, provide temporary treads, platforms, and railings for use by construction personnel.
- B. Use of Existing Stairs, Elevators, Hoists, and Similar Facilities:
1. Stairs in existing building shall not be used by construction personnel.
 2. Elevators in the existing building shall not be used by construction personnel.
 3. Maintain all existing facilities and equipment in a condition equivalent to or better than condition at beginning of usage.

3.10 TEMPORARY ENCLOSURES:

- A. New Construction:
1. Provide temporary enclosure of exterior walls as Work progresses, to provide acceptable working conditions, weather protection for interior materials, allow for effective temporary heating, and to prevent entry of unauthorized persons.

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES: continued

- a. Provide temporary exterior doors with hardware, including being lockable.
 - b. Other enclosures shall be removable as necessary for Work and for handling of materials.
2. Restore permanent facilities used for temporary purposes to specified condition.
- B. Existing Construction:
1. Provide temporary enclosures to separate Work areas from the areas of existing building occupied by Owner to prevent penetration of dust or moisture into occupied areas, to prevent damage to existing equipment, and to protect Owner's employees and operations from construction Work.
 - a. Temporary Partition and Ceiling Enclosures: Framing and sheet materials which comply with structural and fire rating requirements of applicable codes and standards.
 - b. Close joints between sheet materials and seal edges and intersections with existing surfaces. Prevent penetration of dust or moisture.
 - c. In locations where fire protection is required, provide the fire protection as required by local fire regulations.
 2. Restore existing facilities used for temporary purposes to original or better condition.

3.11 TEMPORARY SAFETY AND HEALTH:

- A. General: Contractor shall be solely responsible for initiating, maintaining, and supervising all safety and health precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide necessary protections to prevent injury or loss to, all employees on the Work and other persons and organizations who may be affected thereby.

3.12 TEMPORARY FIRE PROTECTION:

- A. General:
1. Contractor shall be responsible for development of a fire prevention and protection program for all Work under this Contract.
 2. The program shall comply with the applicable provisions for safety and protection specified in the Contract Documents and with applicable parts of the NFPA 10 and 241.
 3. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near such usable stairwell.
 4. Store combustible materials in containers in fire-safe locations.
 5. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
 6. Provide supervision of welding operations and similar sources of fire ignition.
 7. Post warning and instructions at each extinguisher location, and instruct construction personnel on proper use of extinguishers and other available facilities at Project Site. Post local fire department telephone number on or near each telephone instrument at Project Site.
- B. Permanent Fire Protection:
1. Complete each fire protection facility at earliest reasonable date, place into operation, and make ready for emergency use.
 2. Instruct personnel at Site on availability and proper use.

SECTION 01 51 00 – TEMPORARY UTILITIES AND FACILITIES: continued

3.13 INSTALLATION AND REMOVAL:

- A. Relocation: Relocate construction aids as required by progress of construction, storage limitations, or Work requirements and to accommodate requirements of Owner and other contractors at the Site.
- B. Removal: Remove temporary materials, equipment, and services when construction needs can be met and allowed by use of permanent construction, or at completion of the Project.
- C. Repair: Clean and repair damage caused by installation or by use of temporary facilities.
 - 1. Remove foundations and underground installations for construction aids.
 - 2. Grade the areas of the Site affected by temporary installations to required elevations and clean the area.

END OF SECTION 01 51 00

SECTION 01 52 00 – FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes requirements for temporary field offices and other structures required for office and storage space required by Contractor and Engineer.

1.02 RELATED REQUIREMENTS:

- A. Equipment and Materials: Section 01 60 00.
- B. Temporary Utilities and Facilities: Section 01 51 00.
- C. Use of Permanent Facilities:
 - 1. Permanent facilities when substantially completed shall not be used for field offices or for storage.

PART 2 - PRODUCTS

2.01 FIELD OFFICES:

- A. General:
 - 1. Provide trailers, mobile buildings, or buildings constructed with floors raised aboveground, with steps, landings, and railings at entrance doors.
 - 2. Buildings shall be structurally sound, secure, and weathertight.
 - 3. Provide appropriate type fire extinguishers at each office and storage area.
 - 4. Maintain offices during progress of the Work.
 - 5. Install office spaces ready for occupancy 15 days after date stated in Notice to Proceed.
- B. Contractor's Office:
 - 1. Provide a field office for Contractor's superintendent on the Site.
 - 2. It shall be of size required for general use, with lights, heat, furnishings, telephone service, and other necessary facilities and utilities required by Contractor's operations.
 - 3. Provide space for manufacturers' field service representative as required.

2.02 STORAGE SHEDS AND TRAILERS:

- A. On Site:
 - 1. Provide temporary buildings or trailers needed for storage of Equipment and Materials installed under this Contract.
 - 2. Provide ventilation and heating as required by Equipment and Material stored.
- B. Off Site:
 - 1. Advise Engineer of any arrangements made for storage of Equipment and Materials in a place other than Owner's Site. Furnish evidence of insurance coverage with Application for Payment as specified by the Contract Documents.

PART 3 - EXECUTION

3.01 LOCATION, INSTALLATION AND MAINTENANCE:

- A. General:
 - 1. Place temporary buildings, trailers, and stored materials in locations acceptable to Owner or Engineer.
 - 2. Install field offices and sheds to resist winds and elements of the locality where installed.
 - 3. Remove when no longer needed at the Site or when Work is completed.
 - 4. Keep approach walks free of leaves, mud, water, ice, or snow.

SECTION 01 52 00 – FIELD OFFICES AND SHEDS: continued

5. At completion of Work, remove temporary buildings and trailers, foundations if any, utility services, and debris.
6. Prepare ground or paved areas as specified in applicable Sections.

END OF SECTION 01 52 00

SECTION 01 57 00 – TEMPORARY BARRIERS AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes General Requirements for:
 - 1. Safety and protection of Work.
 - 2. Safety and protection of existing property.
 - 3. Barriers.
 - 4. Security.
 - 5. Environmental controls.
 - 6. Access roads and parking areas.
 - 7. Traffic control and use of roadways.

1.02 RELATED REQUIREMENTS:

- A. "Temporary Utilities and Facilities": Section 01 51 00.

PART 2 - PRODUCTS – NOT APPLICABLE.

PART 3 - EXECUTION

3.01 SAFETY AND PROTECTION OF WORK AND PROPERTY:

- A. General:
 - 1. Provide for the safety and protection of the Work and of Materials and Equipment to be incorporated therein, whether in storage on or off the Site. Provide protection at all times against rain, wind, storms, frost, freezing, condensation, or heat so as to maintain all Work and Equipment and Materials free from injury or damage. At the end of each day, all new Work likely to be damaged shall be appropriately protected.
 - 2. Notify Engineer immediately at any time operations are stopped due to conditions which make it impossible to continue operations safely or to obtain proper results.
 - 3. Construct and maintain all necessary temporary drainage and do all pumping necessary to keep excavations, floors, pits, trenches, manholes, and ducts free of water.
 - 4. Protect floors from damage by proper covering and care when handling heavy equipment, painting, or handling mortar or other such materials. Use proper cribbing and shoring to prevent overloading of floors while moving heavy equipment. Provide metal pans under pipe-threading machines and clean such pans daily, keeping oil off floors. Restore floors to former condition where damaged or stained.
 - 5. Concrete floors less than 28 days old shall not be loaded without written permission from Engineer.
 - 6. Restrict access to roofs except as required by the Work. Where access is required, provide protection with plywood, boards, or other suitable materials.

3.02 BARRIERS:

- A. General:
 - 1. Furnish, install, and maintain suitable barriers as required to prevent public entry, to protect the public, and to protect the Work, existing facilities, trees, and plants from construction operations. Remove when no longer needed or at completion of Work.
 - 2. Materials may be new or used, suitable for the intended purpose, but shall not violate requirements of applicable codes and standards or regulatory agencies.
 - 3. Barriers shall be of a neat and reasonable uniform appearance, structurally adequate for the required purposes.

SECTION 01 57 00 – TEMPORARY BARRIERS AND CONTROLS: continued

4. Maintain barriers in good repair and clean condition for adequate visibility. Relocate barriers as required by progress of Work.
 5. Repair damage caused by installation and restore area to original or better condition. Clean the area.
- B. Tree and Plant Protection:
1. Preserve and protect existing trees and plants at the Site which are designated to remain and those adjacent to the Site.
 2. Provide temporary barriers around each, or around each group of trees and plants. Construct to a height of six feet around trees, and to a diameter at the drip line or five feet from trunk, whichever is greater, to adequately protect plants.
 3. Consult with Engineer and remove agreed-on roots and branches which will interfere with construction. Employ qualified tree surgeon to remove and to treat cuts.
 4. Protect root zones of trees and plants as follows:
 - a. Do not allow vehicular traffic or parking.
 - b. Do not store materials or products.
 - c. Prevent dumping of refuse or chemically injurious materials or liquids.
 - d. Prevent puddling or continuous running water.
 5. Carefully supervise excavating, grading and filling, and subsequent construction operations to prevent damage.
 6. Remove and replace, or suitably repair, trees and plants which are damaged or destroyed due to construction operations, and which were designated to remain.

3.03 ENVIRONMENTAL CONTROLS:

- A. Noise Control: Conforming to OSHA requirements.
- B. Dust Control:
1. Provide positive methods and apply dust control materials to minimize raising dust from construction operations; and to prevent airborne dust from dispersing into the atmosphere.
 2. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
 3. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.
- C. Water and Erosion Control:
1. Provide methods to control surface water to prevent damage to the Project, the Site, or adjoining properties.
 2. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 3. Hold the areas of bare soil exposed at one time to a minimum.
 4. Provide temporary control measures such as berms, dikes, and drains.
 5. Control fill, grading, and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff.
 6. Provide, operate, and maintain hydraulic equipment of adequate capacity to control surface and groundwater.
 7. Treat and dispose of surface runoff water in a manner to prevent flooding, erosion, sedimentation, or other damage to any portion of the Site or to adjoining areas, and in a manner acceptable to authorities having jurisdiction.

SECTION 01 57 00 – TEMPORARY BARRIERS AND CONTROLS: continued

8. Provide temporary drainage where the roofing or similar waterproof deck construction is completed prior to the connection and operation of the permanent drainage piping system.
- D. Rodent Control:
1. Provide rodent control as necessary to prevent infestation of construction or storage areas.
 - a. Employ methods and use materials which will not adversely affect conditions at the Site or adjoining properties.
 - b. Should the use of rodenticides be considered necessary, submit an informational copy of the proposed program to Owner with a copy to Engineer. Clearly indicate:
 - (1) The area or areas to be treated.
 - (2) The rodenticides to be used, with a copy of the manufacturer's printed instructions.
 - (3) The pollution preventive measures to be employed.
 2. The use of any rodenticide shall be in accordance with the manufacturer's printed instructions and regulatory agencies.
- E. Debris Control and Clean-Up:
1. Keep the premises free at all times from accumulations of debris, waste materials, and rubbish caused by construction operations and employees. Responsibilities shall include:
 - a. Adequate trash receptacles about the Site, emptied promptly when filled.
 - b. Periodic cleanup to avoid hazards or interference with operations at the Site and to maintain the Site in a reasonably neat condition.
 - c. The keeping of construction materials such as forms and scaffolding neatly stacked.
 - d. Immediate cleanup to protect the Work by removing splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from walls, floors, and metal surfaces before surfaces are marred.
 2. Prohibit overloading of trucks to prevent spillages on access and haul routes. Provide periodic inspection of traffic areas to enforce requirements.
 3. Final cleanup is specified in Section 01 78 00 - Contract Closeout.
- F. Pollution Control:
1. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of hazardous or toxic substances from construction operations.
 2. Provide equipment and personnel, perform emergency measures required to contain any spillages, and remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-Site in approved locations, and replace with suitable compacted fill and topsoil.
 3. Take special measures to prevent harmful substances from entering public waters, sanitary, or storm sewers.

3.04 ACCESS ROADS AND PARKING AREAS:

- A. New Temporary On-Site Roads and Parking Areas:
1. Locate roads, drives, walks, and parking facilities to provide access to construction offices, mobilization, Work, storage areas, and other areas required for execution of the Contract.
 - a. Consult with Engineer regarding any desired deviation therefrom.

SECTION 01 57 00 – TEMPORARY BARRIERS AND CONTROLS: continued

- b. Size of parking facilities shall be adequate to provide for needs of Contractor's personnel, Resident Project Representatives, and visits to Site by Engineer and Owner.
 - 2. Provide access for emergency vehicles. Maintain driveways a minimum of 15 feet wide between and around combustible materials in storage and mobilization areas.
 - 3. Maintain traffic areas free of excavated materials, construction equipment, snow, ice, and debris.
 - 4. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
 - 5. Keep fire hydrants and water control valves free from obstruction and accessible for use.
 - 6. Construction:
 - a. Clear areas required.
 - b. Fill, compact, and grade areas as necessary to provide suitable support for vehicular traffic under anticipated loadings. Materials and construction shall be as specified in DIVISION 2.
 - c. Provide for surface drainage of facilities and surrounding areas.
 - d. Maintain roads, walks, and parking areas in a sound, clean condition. Repair or replace portions damaged during progress of Work.
 - 7. Removal:
 - a. Completely remove temporary materials and construction when construction needs can be met by use of permanent installation, unless construction is to be integrated into permanent construction. Remove and dispose of compacted materials to depths required by various conditions to be met in completed Work.
 - b. Restore areas to original, better, or specified condition at completion of Work.
- B. Existing On-Site Roads and Parking Areas:
 - 1. Designated existing on-Site streets and parking facilities may be used for construction traffic.
 - a. Provide temporary additional roads as needed for required construction access.
 - b. Maintain existing construction, and restore to original, better, or specified condition at completion of Work.
 - c. Do not allow heavy vehicles or construction equipment in parking areas.

3.05 TRAFFIC CONTROL AND USE OF ROADWAYS:

- A. Traffic Control:
 - 1. Provide, operate, and maintain equipment, services, and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow on haul routes, at Site entrances, on-Site access roads, and parking areas. This includes traffic signals and signs, flagmen, flares, lights, barricades, and other devices or personnel as necessary to adequately protect the public.
 - 2. Remove temporary equipment and facilities when no longer required. Restore grounds to original, better, or specified condition when no longer required.
 - 3. Provide and maintain suitable detours or other temporary expedients if necessary.
 - 4. Bridge over open trenches where necessary to maintain traffic.
 - 5. Consult with governing authorities to establish public thoroughfares which will be used as haul routes and Site access. All operations shall meet the approval of owners or agencies having jurisdiction.
- B. Maintenance of Roadways:

SECTION 01 57 00 – TEMPORARY BARRIERS AND CONTROLS: continued

1. Repair roads, walkways, and other traffic areas damaged by operations. Keep traffic areas as free as possible of excavated materials and maintain in a manner to eliminate dust, mud, and hazardous conditions.
2. All operations and repairs shall meet the approval of owners or agencies having jurisdiction.

END OF SECTION 01 57 00

SECTION 01 58 00 – PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes basic requirements for temporary Project identification and informational signs required during construction.

1.02 RELATED REQUIREMENTS:

- A. Submittals: Section 01 33 00.
- B. Protective Coatings: Section 09 90 00.

1.03 QUALITY ASSURANCE:

- A. Design sign and structure to withstand wind and environmental conditions of locality. Provide with finish adequate to withstand weathering, fading, chipping, and peeling for duration of construction.

1.04 SUBMITTALS:

- A. Submit as specified in Section 01 33 00.
- B. Includes, but not limited to, the following:
 - 1. Shop Drawings and product data as applicable.
 - 2. Show content, layout, lettering, colors, structure, and foundation.

PART 2 - PRODUCTS

2.01 IDENTIFICATION SIGNS:

- A. Project Identification:
 - 1. Construct to design, size, and material indicated.
 - 2. Construct structure and framing of wood or metal, structurally adequate to resist design requirements of locality.
 - 3. Construct sign surface of minimum 3/4-inch thickness exterior grade plywood with medium density overlay. Panels shall be of size to minimize joints. Overall size shall be 4'x8'.
 - 4. Rough hardware shall be galvanized or aluminum.
 - 5. Coating: Paint as specified in Section 09 90 00 of colors selected by Engineer/Architect.
 - a. Coating System A1 for metal.
 - b. Coating System K5 for wood.
 - 6. Information Content:
 - a. Project title, logo, and name of Owner as shown on Contract Documents.
 - b. Names and titles of authorities.
 - c. Name and title of Engineer.
 - d. Name of prime Contractor and major Subcontractors.
- B. Contractor Identification: If not part of Project identification sign, provide and install Contractor's standard sign.

2.02 INFORMATIONAL SIGNS:

- A. Construction:
 - 1. This includes signs for traffic, construction workers, and general public in regards to directions, warnings, hazards, locations of areas, facilities, equipment, and others of a similar nature.

SECTION 01 58 00 – PROJECT IDENTIFICATION AND SIGNS: continued

2. Provide signs of design, size, color, and lettering as required by regulatory agencies. Signs shall be painted metal, wood, plastic, or fiberglass and of materials suitable for the conditions in which they are placed, such as weathering and fading.
3. Construct structure and framing of wood or metal, structurally adequate to resist design requirements of area of Project.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Project and Contractor Identification Sign:
 1. Install in appropriate location so as not to obstruct traffic, pedestrians, or construction operations.
 2. Erect on framing or foundation, and rigidly brace.
 3. Maintain sign in good repair, in a clean and neat condition.
 4. Remove upon completion of Project.
- B. Informational Signs:
 1. Install at appropriate locations and in sufficient quantities to assure visibility. Relocate as required by progress of Work.
 2. Maintain signs in good repair, in a neat, clean, readable condition.
 3. Remove all signs, framing, supports, and foundations upon completion of Project.

END OF SECTION 01 58 00

SECTION 01 60 00 – EQUIPMENT AND MATERIALS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative and procedural requirements governing Contractor's selection of products for use in the Project.

1.02 RELATED REQUIREMENTS:

- A. The following Sections contain requirements that relate to this Section:
- B. For the applicability of industry standards to products specified: DIVISIONS 2 through 46.
- C. For submittal of Contractor's construction progress schedule and the Submittal schedule: Sections 01 32 00 and 01 33 00.
- D. For handling requests for substitutions made after award of the Contract: Section 01 25 00.

1.03 DEFINITIONS:

- A. Definitions used in this Article are not intended to change the meaning of other terms used in these Contract Documents, such as "specialties," "systems," "structures," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "Material," "Equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - 2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
 - 3. "Equipment" is a product with operational or nonoperational parts, whether motorized, or manually operated, that may require service connections, such as wiring or piping.

1.04 SUBMITTALS:

- A. Submittal of preliminary procurement schedule is specified in Section 01 32 00 - Construction Progress Schedules and Reports.
- B. Submittals for products are specified in Section 01 33 00 and in applicable Sections of DIVISIONS 2 through 46.

1.05 QUALITY ASSURANCE:

- A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
- B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
- C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated Equipment. Locate on an easily accessible surface that is

SECTION 01 60 00 – EQUIPMENT AND MATERIALS: continued

inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

- a. Name of product and manufacturer including address (and telephone number).
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
- D. Electronic Equipment Compliance:
1. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time data including without limitation: calculating, comparing, and sequencing. This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

1.06 TRANSPORTATION AND SHIPMENT:

- A. Shipment Preparation:
1. Contractor shall require manufacturers and Suppliers to prepare products for shipment in a manner to facilitate unloading and handling, and to protect against damage, deterioration, or unnecessary exposure to the elements in transit and storage. Provisions for protection shall include the following:
 - a. Crates or other suitable packaging materials.
 - b. Covers and other means to prevent corrosion, moisture damage, mechanical injury, and accumulation of dirt in motors, electrical equipment, and machinery.
 - c. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel.
 - d. Grease packing or oil lubrication in all bearings and similar items.
- B. Marking: Each product item shall be tagged or marked as identified in the delivery schedule or on Submittals. Complete packing lists and bills of material shall be included with each shipment. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
1. Schedule delivery to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Allow ample time to avoid delay of the Work.
 2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to the Site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected. Inspect shipment to assure:
 - a. Product complies with requirements of Contract Documents and reviewed Submittals.

SECTION 01 60 00 – EQUIPMENT AND MATERIALS: continued

- b. Quantities are correct.
 - c. Containers and packages are intact and labels are legible.
 - d. Products are properly protected and undamaged.
 5. Store products at the Site in a manner that will facilitate inspection and measurement of quantity or counting of units. Mark deliveries of component parts of Equipment to identify the Equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units.
 6. Store heavy Materials away from the Project structure in a manner that will not endanger the supporting construction.
 7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, and with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
 8. Protect motors, electrical Equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
 9. Protect exposed machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
 10. Protect bearings and similar items with grease packing or oil lubrication.
 11. Handle and store steel plate, sheet metal, and similar items in a manner to prevent deformation.
- B. Handling:
1. Provide equipment and personnel necessary to unload and handle products, by methods to prevent damage or soiling to products, or packaging.
 2. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points.
 3. Provide additional protection to surrounding surfaces as necessary to prevent damage.
- C. Maintenance of Storage:
1. Inspect stored products on a scheduled basis.
 2. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained.
 3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.
 4. For mechanical and electrical Equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions on exterior of package. Service Equipment on a regularly scheduled basis.
- D. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from subsequent construction operations. Remove coverings when no longer needed or as specified.

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION:

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise specified or indicated, new at the time of installation.
1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 2. Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

SECTION 01 60 00 – EQUIPMENT AND MATERIALS: continued

3. Continued Availability: Where, because of the nature of its application, Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard products for which the manufacturer has published assurances that the products and its parts are likely to be available to Owner at a later date.
4. Conform to applicable Specifications, codes, standards, and regulatory agencies.
5. Comply with size, make, type, and quality specified, or as specifically approved in writing by Engineer.
6. Manufactured and Fabricated Products:
 - a. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
 - c. Equipment and Materials shall be suitable for service conditions intended.
 - d. Equipment capacities, sizes, and dimensions indicated or specified shall be adhered to unless variations are specifically approved in writing by Engineer.
 - e. Provide labels and nameplates where required by regulatory agencies or to state identification and essential operating data.
7. Do not use products for any purpose other than that for which designed.
8. To the fullest extent possible, provide products of the same kind from a single source.

PART 3 - EXECUTION

3.01 INSTALLATION OF PRODUCTS:

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place except as required for proper movement and performance, and accurately located and aligned with other Work.
 1. Obtain and distribute copies of manufacturer's printed instructions and recommendations if not a part of Submittals, containers, or packaging to parties involved in the installation, including a copy to Engineer.
 2. Maintain one complete set of instructions at the Site during installation and until completion.
 3. Handle, install, connect, clean, condition, and adjust products in accordance with such instructions and in conformance with specified requirements. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
- B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 60 00

SECTION 01 73 29 – CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY:

- A. Definition: Cutting and patching includes cutting into existing construction to provide for the installation of Work, and the repair required to restore materials to their original or better condition.
 - 1. Cutting and patching is performed for coordination of the Work, to uncover Work for access or inspection, to obtain samples for testing, to permit alterations to be performed, or for other similar purposes.
 - 2. Cutting and patching performed during the manufacture of products or during the initial fabrication, erection, or installation process is not considered to be cutting and patching under this definition. Drilling of holes to install fasteners and similar operations is also not considered to be cutting and patching.

1.02 RELATED REQUIREMENTS:

- A. Refer to DIVISION 02 for demolition of selected portions of the building for alterations.
- B. Refer to other Sections of these Specifications for specific cutting and patching requirements and limitations applicable to individual units of Work.

1.03 SUBMITTALS:

- A. Cutting and Patching Proposal: Submit a proposal describing procedures well in advance of the time cutting and patching will be performed if Owner requires approval of these procedures before proceeding. Request approval to proceed. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
 - 2. Describe anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 - 3. List products to be used and firms or entities that will perform Work.
 - 4. Indicate dates when cutting and patching will be performed.
 - 5. List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.

1.04 QUALITY ASSURANCE:

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.
 - 1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Foundation construction.
 - b. Bearing and retaining walls.
 - c. Structural concrete.
 - d. Structural steel.
 - e. Lintels.
 - f. Timber and primary wood framing.
 - g. Structural decking.
 - h. Stair systems.
 - i. Miscellaneous structural metals.

SECTION 01 73 29 – CUTTING AND PATCHING: continued

- j. Exterior curtain-wall construction.
 - k. Equipment supports.
 - l. Piping, ductwork, vessels, and Equipment.
- B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.
- 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and Equipment.
 - b. Air or smoke barriers.
 - c. Water, moisture, or vapor barriers.
 - d. Membranes and flashings.
 - e. Fire protection systems.
 - f. Noise and vibration control elements and systems.
 - g. Control systems.
 - h. Communication systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner.
- 1. If possible retain the original installer or fabricator to cut and patch the exposed Work listed below. If it is impossible to engage the original installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.
 - d. Matched-veneer woodwork.
 - e. Preformed metal panels.
 - f. Firestopping.
 - g. Window wall system.
 - h. Stucco and ornamental plaster.
 - i. Acoustical ceilings.
 - j. Terrazzo.
 - k. Finished wood flooring.
 - l. Fluid-applied flooring.
 - m. Carpeting.
 - n. Aggregate wall coating.
 - o. Wall covering.
 - p. Swimming pool finishes.
 - q. HVAC enclosures, cabinets, or covers.

1.05 WARRANTY:

- A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

SECTION 01 73 29 – CUTTING AND PATCHING: continued

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. **GENERAL:** Except as otherwise indicated, specified, or as directed by Engineer, use materials for cutting and patching that are identical to existing materials. If identical materials are not available or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Before cutting, examine the surfaces to be cut and patched and the conditions under which the Work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the Work.
- B. Before the start of cutting Work, meet at the Project site with all parties involved in cutting and patching. Review areas of potential interference and conflict between the various trades. Coordinate procedures and resolve potential conflicts before proceeding with the Work.

3.02 PREPARATION:

- A. **Temporary Support:** Provide adequate temporary support of Work to be cut to prevent failure.
- B. **Protection:** Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that may be exposed during cutting and patching operations. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- C. **Precautions:** Take precautions not to cut existing pipe, conduit, or ductwork serving the building, but scheduled to be removed or relocated, until provisions have been made to bypass them.

3.03 PERFORMANCE:

- A. **General:** Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete Work without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. **Cutting:**
 - 1. Cut existing construction using methods that are least likely to damage elements to be retained, or adjoining construction. Where possible, review proposed procedures with the original installer.
 - 2. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.
 - 3. Comply with requirements of applicable Sections of DIVISION 31 where cutting and patching requires excavating and backfilling.
- C. **Patching:**

SECTION 01 73 29 – CUTTING AND PATCHING: continued

1. Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the Work.
2. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
3. Restore exposed finishes of patched areas and where necessary extend finish restoration into retained adjoining Work in a manner which will eliminate evidence of patching and refinishing.
4. Where removal of walls or partitions extends one finished area into another finished area, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. If necessary to achieve uniform color and appearance, remove existing floor and wall coverings and replace with new materials.
 - a. Where patch occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and second coat.
5. Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.04 CLEANING:

- A. Thoroughly clean areas and spaces where Work is performed. Remove dirt, dust, grease, paint splatter, mortar, oils, sealants, and items of similar nature. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29

SECTION 01 75 00 – MANUFACTURER'S FIELD SERVICES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This section includes requirements of manufacturers for services to be performed at the Project Site in regards to erection, start-up, and testing of Equipment.

1.02 SERVICES REQUIRED:

- A. Services with Equipment and Materials Furnished Under this Contract:
 - 1. Furnish the services of qualified field personnel from the Suppliers or manufacturers of Equipment furnished and installed under this Contract, as required to perform all manufacturer's Field Services called for in the Specifications. Field personnel shall be certified by the Supplier or manufacturer of the specific product or system as having the necessary knowledge and experience to perform the required functions.
 - 2. Where such service is specified, Contractor shall not perform any Work related to the installation or operation of Equipment furnished and installed under this Contract without direct observation and guidance of the Supplier's or manufacturer's field personnel unless Engineer concurs otherwise.
 - 3. Contractor shall arrange for the Supplier's or manufacturer's field personnel to perform the following:
 - a. Observe the erection, installation, start-up, and testing of Equipment.
 - b. Instruct and guide Contractor in proper procedures.
 - c. Supervise the initial start-up, operational check, and any required adjustments of Equipment.
 - d. Instruct Owner's designated personnel in proper operation and maintenance of all Equipment.
 - e. Furnish a written report to Engineer covering all Work done at least once each week and when Work on each item of Equipment or system is completed.
 - 4. Advise Engineer of arrival at the Site of all Supplier's and manufacturer's field personnel.

PART 2 - PRODUCTS: SPECIFIED IN APPLICABLE SECTIONS.

PART 3 - EXECUTION

3.01 OPERATION AND TESTING:

- A. Placing Equipment in Operation:
 - 1. Place all Equipment installed under this Contract into successful operation according to instructions of the Supplier, manufacturer, or field representative, including making all required adjustments, tests, operation checks, and the following:
 - a. Cleaning, sounding, blowing-out, and flushing of lubricating oil and water systems, and other pipelines.
 - b. Lubrication shall be supplied by Contractor unless specified to be furnished by Owner or others.
 - c. Tests of lubrication system safety interlocks and system performance.
 - d. Final alignment checks and measurements made under observation of Engineer and Owner. Alignment checks shall include opening connections, if required, to ensure there are no abnormal stresses on Equipment from pipes, ducts, or other attachments. Alignment shall be within tolerances specified by the manufacturer, and measurements shall be recorded and furnished to Engineer.
 - e. Motor rotation checks before connecting couplings.

SECTION 01 75 00 – MANUFACTURER'S FIELD SERVICES: continued

- f. Inspection of sleeve bearings for adequate contact.
 - g. Checking of anchor-bolt tensions, grout, and shims. Tighten anchor bolts with calibrated torque wrenches using care not to over stress bolts.
 2. After "run-in" and acceptance of alignment, affix major Equipment in place using standard tapered dowels with jack-out nuts at head end to facilitate removal.
 3. Record all above operations on forms furnished by Engineer.
 4. Furnish all necessary attendants and personnel as part of the Work to accomplish the above operations until such time as individual items, systems, Equipment, or sections of the plant are acceptable for operation by Owner.
 5. Contractor shall provide fuel, electricity, water, and lubricants for placing Equipment in operation. Owner's operating personnel will assist.
- B. Performance Tests:
1. Equipment Furnished Under this Contract:
 - a. Owner may conduct acceptance tests after installation to determine if the Equipment installed as part of the Work perform in accordance with Contract Documents and as guaranteed. Final acceptance of Equipment or Substantial Completion will be based on acceptable results of such tests.
 - b. No tests will be conducted on Equipment for which Supplier's or manufacturer's Field Service is specified unless Supplier's or manufacturer's field representative is present and declares in writing that the Equipment is ready for such test.
 - c. Contractor will be notified by Owner so that Contractor can have a representative or manufacturer's representative present during any tests of Equipment for which Supplier's or manufacturer's Field Service is not specified.
 - d. The tests will be made as set forth in the Contract Documents unless the interested parties mutually agree upon some other manner of testing.

END OF SECTION 01 75 00

SECTION 01 78 00 – CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative and procedural requirements for Contract closeout including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Instruction book and operating manual submittal.
 - 4. Submittal of warranties.
 - 5. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections of the Specifications.

1.02 RELATED REQUIREMENTS:

- A. Prerequisites to Substantial Completion and Final Acceptance: GENERAL CONDITIONS.
- B. Submittals: Section 01 33 00.
- C. Manufacturer's Field Service: Section 01 75 00.
- D. Warranties: Section 01 78 36.

1.03 SUBSTANTIAL COMPLETION:

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the portion of the Work claimed as Substantially Complete.
 - a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Price.
 - b. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete Work, and reasons the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship Bonds, maintenance agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases enabling Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Submit record drawings, instruction books and operating manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra stock, and similar items.
 - 7. Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 8. Complete start-up testing of systems and instruction of Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the Site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleanup requirements, including touchup painting.
 - 10. Touch up and otherwise repair and restore marred, exposed finishes.
- B. Inspection Procedures: On receipt of a request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled requirements. Engineer will prepare the

SECTION 01 78 00 – CONTRACT CLOSEOUT: continued

Certificate of Substantial Completion following inspection or advise Contractor of construction that must be completed or corrected before the certificate will be issued.

1. Engineer will repeat inspection when requested and assured by Contractor that the Work is Substantially Complete.
2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.04 FINAL ACCEPTANCE:

- A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
 1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
 2. Submit an updated final statement, accounting for final additional changes to the Contract Price.
 3. Submit a certified copy of Engineer's final inspection list of items to be completed or corrected, endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Engineer.
 4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the Date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 5. Submit consent of surety to final payment.
 6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 7. Submit a final liquidated damages settlement statement.
- B. Reinspection Procedure: Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer.
 1. Upon completion of reinspection, Engineer will prepare a certificate of final acceptance. If the Work is incomplete, Engineer will advise Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 2. If necessary, reinspection will be repeated.

1.05 RECORD DOCUMENT SUBMITTALS:

- A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for Engineer's reference during normal working hours.
- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
 1. Record information concurrently with construction progress.
 2. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "PROJECT RECORD" in neat, large, printed letters.

SECTION 01 78 00 – CONTRACT CLOSEOUT: continued

3. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings.
 4. Note related Change Order numbers where applicable.
 5. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
 6. Upon completion of the Work, submit record drawings to Engineer for Owner's records.
 7. Include the following:
 - a. Depths of various elements of foundation in relation to finish first floor datum.
 - b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of construction.
 - d. Where Submittals are used for mark-up, record a cross-reference at corresponding location on Drawings.
 - e. Field changes of dimension and detail.
 - f. Changes made by Change Order or other Modifications.
 - g. Details not on original Contract Drawings.
- C. Record Specifications: Maintain one complete copy of the Project Manual including Addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction.
1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
 2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
 3. Note related record drawing information and product data.
 4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records.
 5. Include the following:
 - a. Manufacturer, trade name, catalog number, and Supplier of each product and item of Equipment actually installed, particularly optional and substitute items.
 - b. Changes made by Addendum, Change Order, or other Modifications.
 - c. Related Submittals.
- D. Record Product Data: Maintain one copy of each product data Submittal. Note related Change Orders and markup of record drawings and specifications.
1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.
 2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
 3. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records.
- E. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records, and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records.
- F. Instruction Books and Operating Manuals: Organize operation and maintenance data into suitable sets of manageable size as specified in Section 01 33 00.

SECTION 01 78 00 – CONTRACT CLOSEOUT: continued

- G. Electronic Documentation:
 - 1. In addition to paper copies, provide electronic versions of record documents showing "as-constructed" conditions, "as-constructed" construction progress schedule, master field drawing list showing final revisions, instruction books, and operating manuals as specified.
 - H. Warranties and Bonds: Specified in GENERAL CONDITIONS, Section 01 33 00, and Section 01 78 36.
- 1.06 SPARE PARTS:
- A. Products Required:
 - 1. Provide to Owner the quantities of products, spare parts, maintenance tools, and maintenance materials specified in individual Sections, in addition to that required for completion of Work.
 - 2. Products shall be identical to those installed in the Work. Include quantities required from Supplier or manufacturer of original purchase to avoid variations in manufacture.
 - B. Storage, Maintenance:
 - 1. Coordinate with Owner. Deliver and unload spare products to Owner at Project Site and obtain receipt prior to final payment.
 - 2. For portions of the Work accepted and occupied by Owner prior to Substantial Completion, deliver the applicable spare products to Owner at time of acceptance. Obtain receipt.
 - 3. Maintain spare products in original containers with labels intact and legible, until delivery to Owner.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

- 3.01 CLOSEOUT PROCEDURES:
- A. Operation and Maintenance Instructions: Arrange for each installer of Equipment that requires regular maintenance to meet with Owner's personnel at Project Site to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:
 - 1. Instruction books and operating manuals.
 - 2. Record documents.
 - 3. Spare parts and materials.
 - 4. Tools.
 - 5. Lubricants.
 - 6. Fuels.
 - 7. Identification systems.
 - 8. Control sequences.
 - 9. Hazards, hazardous chemicals data sheets.
 - 10. Cleaning.
 - 11. Warranties and bonds.
 - 12. Maintenance agreements and similar continuing commitments.
 - B. As part of instruction for operating Equipment, demonstrate the following procedures:
 - 1. Start-up.
 - 2. Shutdown.

SECTION 01 78 00 – CONTRACT CLOSEOUT: continued

3. Emergency operations.
 4. Noise and vibration adjustments.
 5. Safety procedures.
 6. Economy and efficiency adjustments.
 7. Effective energy utilization.
- C. Manufacturer's Field Services: Specified in Section 01 75 00.

3.02 FINAL CLEANING:

- A. General: Contractor shall keep the Site premises free from accumulations of waste materials, rubbish, and other debris resulting from the Work. Regular Site cleaning is included in Section 01 57 00.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
 - a. Remove labels that are not permanent labels.
 - b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Clean concrete floors to a "broom clean" condition. Vacuum carpeted surfaces.
 - d. Wipe surfaces of mechanical and electrical Equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
 - e. Remove debris and surface dirt from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.
 - f. Clean the Site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.
 - g. Clean and polish plumbing fixtures to a sanitary condition, free of stains including those resulting from water exposure.
 - h. Clean light fixtures and lamps so as to function with full efficiency.
 2. Remove temporary structures, tools, equipment, supplies, and surplus materials.
 3. Remove temporary protection devices and facilities which were installed to protect previously completed Work.
 4. Special Cleaning: Cleaning for specific units of Work is specified in applicable Sections of Specifications.
- C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Site and dispose of lawfully.

SECTION 01 78 00 – CONTRACT CLOSEOUT: continued

1. Extra materials of value remaining after completion of associated Work become Owner's property. Dispose of these materials as directed by Owner.
- E. Repairs:
1. Repair damaged protective coated surfaces.
 2. Repair roads, walks, fences, and other items damaged or deteriorated because of construction operations.
 3. Restore all ground areas affected by construction operations.

END OF SECTION 01 78 00

SECTION 01 78 36 – WARRANTIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers' standard warranties on products and special warranties.
 - 1. Refer to the GENERAL CONDITIONS for terms of the Contractor's period for correction of the Work.

1.02 RELATED SECTIONS:

- A. The following Sections contain requirements that relate to this Section:
 - 1. Procedures for submitting warranties: Section 01 33 00.
 - 2. Contract closeout procedures: Section 01 78 00.
 - 3. Specific requirements for warranties on products and installations specified to be warranted: DIVISIONS 2 through 46.
 - 4. Certifications and other commitments and agreements for continuing services to Owner: Specified throughout the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve Suppliers, manufacturers, and Subcontractors required to countersign special warranties with Contractor.

1.03 DEFINITIONS:

- A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by manufacturer to Owner.
- B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for Owner.

1.04 WARRANTY REQUIREMENTS:

- A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted construction.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Expressed warranties made to Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the Law. Expressed warranty periods shall not be interpreted as limitations on the time in which Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

SECTION 01 78 36 – WARRANTIES: continued

- E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, Owner reserves the right to refuse to accept the Work, until Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.05 SUBMITTALS:

- A. Submit written warranties to Engineer prior to the date certified for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the Date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of Engineer.
- B. When the Contract Documents require Contractor, or Contractor and a Subcontractor, Supplier, or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by required parties. Submit a draft to Owner, through Engineer, for approval prior to final execution.
- C. Forms for special warranties are included at the end of this Section. Prepare a written document using the appropriate form, ready for execution by Contractor, or by Contractor and a Subcontractor, Supplier, or manufacturer. Submit a draft to Owner, through Engineer, for approval prior to final execution.
 - 1. Refer to DIVISIONS 2 through 46 Sections for specific content requirements and particular requirements for submitting special warranties.
- D. Form of Submittal: At Final Completion, compile two copies of each required warranty properly executed by Contractor, or by Contractor and a Subcontractor, Supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Contract Documents.
- E. Bind warranties and bonds in heavy-duty, commercial-quality, durable three-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the 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 the installer.
 - 2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," and as required by Section 01 33 00.
 - 3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 78 36

DIVISION 03 – CONCRETE

SECTION 031000 – CONCRETE FORMWORK

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. This Section includes formwork for cast-in-place concrete.
- 1.03 RELATED WORK SPECIFIED ELSEWHERE:
- A. Section 032300 - Concrete Reinforcement.
 - B. Section 033000 - Concrete.
- 1.04 REFERENCE STANDARDS:
- A. Applicable Standards:
 - 1. American Concrete Institute (ACI):
 - a. 117 - Specifications for Tolerances for Concrete Construction and Materials.
 - b. 301 - Specifications for Structural Concrete.
 - c. 318 - Building Code Requirements for Structural Concrete.
 - d. 347 - Guide to Formwork for Concrete.
 - 2. American Society for Testing and Materials (ASTM):
 - a. C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - b. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - c. C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.

PART 2 - PRODUCTS

- 2.01 MATERIALS FOR FACING:
- A. Where concrete will be exposed to view after construction:
 - 1. Use exterior grade plywood at least 5/8 inch thick or steel forms capable of producing a smooth, uniform appearance.
 - 2. Do not use form-facing materials with raised grain, torn surfaces, worn edges, dents, or other defects that will impair the texture of concrete surfaces.
 - B. Where concrete will not be exposed to view after construction:
 - 1. Exterior grade plywood at least 5/8 inch thick.
 - 2. Steel.
 - 3. Wood fiberboard.
 - 4. Dressed lumber free of loose knots.
 - C. Treat forms with commercially available form releasing agents that will not bond with, stain, or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion, nor shall it impede the wetting of surfaces to be cured with water or curing compounds. Form releasing agents shall be VOC compliant with a maximum VOC content of 3.8 lbs./gal. (450 g/L), or less where area restrictions are more stringent.

SECTION 031000 – CONCRETE FORMWORK: continued

- D. Clean forms of sawdust, dust, dirt, and other foreign materials.

2.02 FORM TIES:

- A. Break back, coil, or screw type, except where otherwise specified.
- B. Use water-seal coil type in walls below grade and in walls of water bearing structures. Removable through-wall tapered ties shall not be used.
- C. Coil type shall leave conical depression in concrete.
- D. Space as required against pressure of fresh concrete.
- E. The portion of the form tie remaining in place shall provide for a clearance of two times the minimum dimension of the tie, but not less than 3/4 inch, from the formed surface.

2.03 CHAMFER STRIPS:

- A. Chamfer: 3/4 inch except where otherwise indicated.
- B. Place in all forms to provide chamfer where concrete will have exposed projecting corners.

PART 3 - EXECUTION

3.01 FORM CONSTRUCTION:

- A. Conform to ACI 301, 318, and 347, except Shop Drawings for formwork, shoring, and reshoring shall not be submitted for approval.
- B. Adequately brace, stiffen, and support forms to prevent perceptible deflection or settlement, and to hold plumb, level, and true to line.
- C. Construct and maintain forms to the tolerances given in ACI 117.
- D. Construct sufficiently tight to prevent mortar leakage.
- E. Avoid offsets between adjacent forms and construct so that shores, braces, and stiffening members are in line with those below.
- F. Space studs and stringers as required to support facing against concrete pressure, but not more than 12 inches for 5/8-inch plywood or 16 inches for 3/4-inch plywood. Maximum deflection of facing materials reflected on concrete surfaces exposed to view shall be 1/240 of the span between structural members of the formwork.
- G. Use wales, strongbacks, shores, and bracing as required.
- H. Form all necessary openings or chases for piping, ductwork, and similar items where indicated or as required for the Work.
- I. Construct forms to be removable in sections without marring concrete surface.
- J. Surface of forms shall provide a smooth, dense, plane surface to finished concrete where exposed to view.
- K. Contractor shall be responsible for structural adequacy, design, engineering, and construction of the formwork.
- L. Stay-in-place metal forms shall not be used.

3.02 TIME-IN-PLACE FOR FORMS:

- A. It is the responsibility of Contractor to consider all applicable factors and leave the formwork in place until it is safe to remove them.
- B. All removal shall be performed in a manner which will prevent damage to the concrete and ensure the complete safety of the structure.
- C. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements.
- D. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure

SECTION 031000 – CONCRETE FORMWORK: continued

or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C31 and ASTM C39 at the expense of Contractor by an independent laboratory that complies with ASTM C1077. Control cylinders shall be tested within 4 hours after removal from the Site.

- E. Forms shall not be removed unless the minimum time or minimum compressive strength requirements below are met.
1. Formwork Not Supporting Weight of Concrete:
 - a. Formwork for walls, columns, sides of beams, gravity structures, slabs-on-ground and other vertical type formwork not supporting the weight of concrete shall remain in place 24-hours minimum after concrete placement is completed.
 2. Formwork Supporting Weight of Concrete:
 - a. Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, no forms or shoring shall be loosened or removed until control concrete test cylinders indicate the concrete has attained the following compressive strengths for the respective structural members:

| <u>Structural Member</u> | <u>Percent of Design Compressive Strength</u> |
|---|---|
| Unshored slab and beam forms or forms which can be removed without disturbing shores | 70 |
| Slab or beam shoring | 85 |

END OF SECTION 031000

SECTION 031550 – VAPOR RETARDER

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. This Section includes vapor retarder under concrete slabs on grade.
- 1.03 RELATED WORK SPECIFIED ELSEWHERE:
- A. Section 03 30 00 - Concrete.
- 1.04 REFERENCE STANDARDS:
- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. E96 - Test Methods for Water Vapor Transmission of Materials.
 - b. E154 - Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - c. E1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Include, but not limited to, the following:
 - 1. Product specification and data.
 - 2. Installation instructions.

PART 2 - PRODUCTS

- 2.01 VAPOR RETARDER:
- A. Flexible, preformed sheet membrane material conforming to ASTM E1745, Class A or B having a minimum thickness of 10 mils.
 - B. Use under concrete slabs as follows:
 - 1. Lake Fort Smith Fluoride Building.
 - 2. Lee Creek Fluoride Building.

PART 3 - EXECUTION

- 3.01 INSTALLATION:
- A. Remove sharp edges, projecting materials, and roughness which might penetrate vapor retarder.
 - B. Level and tamp or roll granular base.
 - C. Place vapor retarder sheeting with the longest dimension parallel with the direction of the concrete pour.
 - D. Lap vapor retarder over footing or seal to foundation wall, or both, and seal around penetrations such as utilities and columns in order to create a monolithic membrane between the surface of the slab and moisture sources below the slab and at the slab perimeter.
 - E. Lap joints 6 inches, or as instructed by the manufacturer, and seal with the manufacturer's recommended adhesive or pressure sensitive tape, or both.

SECTION 031550 – VAPOR RETARDER: continued

- F. Take precaution to protect vapor retarder from damage during installation of reinforcing steel and utilities and during placement of concrete.
- G. Use only concrete brick type reinforcing bar supports, or provide 6-inch by 6-inch protective pads of asphaltic hardboard or other material recommended by the vapor retarder manufacturer to protect the vapor retarder from puncture.
- H. Do not drive stakes through the vapor retarder.
- I. Repair vapor retarder damaged during placement of reinforcing or concrete as instructed by manufacturer.

END OF SECTION 031550

SECTION 032000 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. This Section includes steel reinforcement bars, ties, welded wire fabric, bolsters, chair supports, and accessories.
- 1.03 RELATED WORK SPECIFIED ELSEWHERE:
- A. Section 031000 - Concrete Formwork.
 - B. Section 033000 - Concrete.
- 1.04 REFERENCE STANDARDS:
- A. Applicable Standards:
 1. American Society for Testing and Materials (ASTM):
 - a. A82 - Steel Wire, Plain, for Concrete Reinforcement.
 - b. A185 - Steel Welded Wire Reinforcement, Plain, for Concrete.
 - c. A615/A615M - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - d. A706/A706M - Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 2. American Concrete Institute (ACI):
 - a. 301 - Specifications for Structural Concrete.
 - b. SP 66 - Detailing Manual.
 - c. 318 - Building Code Requirements for Structural Concrete.
 - d. 117 - Specifications for Tolerances for Concrete Construction and Materials.
 3. American Welding Society (AWS):
 - a. A5.5 - Low Alloy Steel Electrodes for Shielded Metal Arc Welding.
 - b. B2.1 - Welding Procedure and Performance Qualification.
 - c. D1.4 - Structural Welding Code Reinforcing Steel.
 4. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Include, but not limited to, the following:
 1. Complete bar schedule, bar details, and erection drawings to conform to ACI SP 66.
 2. Drawing with each type of bent bar marked with identification mark. Straight bars shall have mark number or be identified by size and length.
 3. Erection drawings shall be clear, easily legible, and to a minimum scale of:
 - a. 1/4 inch = 1 foot (1:50).
 - b. 1/8 inch = 1 foot (1:100) if bars in each face are shown in separate views.
 4. Size and location of all openings.
 5. Concrete protective cover.
 6. Grade of steel.
 7. Lap splice lengths.

SECTION 032000 – CONCRETE REINFORCEMENT: continued

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Store steel reinforcement blocked up off the ground and in orderly stacks.
- B. Store only bars with the same identifying label in the same stack.

1.07 TESTING:

- A. Perform at the mill for each heat.
- B. Submit certified test results upon request.

PART 2 - PRODUCTS

2.01 REINFORCEMENT BARS, TIES, AND STIRRUPS:

- A. Materials:
 - 1. Conform to ASTM A615, Grade 60, except as otherwise specified.
 - 2. Cold-drawn wire for spiral column ties shall conform to ASTM A82.
 - 3. Reinforcement indicated or specified to be welded shall conform to ASTM A706.
- B. Fabrication of Bars:
 - 1. Fabricate with cold bends conforming to the recommended dimensions shown in ACI 318.
 - 2. Fabricate bars according to the tolerances given in ACI 117.
 - 3. Field fabrication will be allowed only if Contractor has equipment to properly fabricate steel.
 - 4. Attach metal or plastic tags with identifying mark or length corresponding to mark number or length on Drawing. Straight bars shall have mark number or size and length. Bent bars shall have mark number.
 - 5. Contractor may, at his option, continue steel reinforcement through openings in walls and slabs, then field-cut the opening so that there will be the required concrete cover between ends of bars and edge of opening.

2.02 WELDED WIRE REINFORCEMENT:

- A. Conform to ASTM A185 using bright basic wire conforming to ASTM A82.
- B. Wire sizes W1.4 and smaller shall be galvanized.
- C. Provide mats only. Rolled fabric is not acceptable.

2.03 BOLSTERS, CHAIRS, AND ACCESSORIES:

- A. Conform to ACI SP 66 and the CRSI Manual of Standard Practice.
- B. Provide all spacers, bolsters, chairs, ties, and other devices necessary to properly space, place, support, and fasten steel reinforcement in place during the concrete placement.
- C. Metal accessories shall be galvanized or plastic-coated where legs will be exposed in finished concrete surfaces.
- D. Do not use rocks, broken bricks, wood blocks, concrete fragments or other debris for support of steel reinforcement.

2.04 PRECAST CONCRETE BLOCK BAR SUPPORTS:

- A. May be used only for bar supports in slabs on ground.
- B. Conform to ACI SP-66 and the CRSI Manual of Standard Practice.
- C. Each block shall have a minimum of 9 square inches (5800 square millimeters) of bearing area. Space as required by the particular condition of weight, bearing surface, and rigidity of the steel reinforcement.

SECTION 032000 – CONCRETE REINFORCEMENT: continued

PART 3 - EXECUTION

3.01 PLACEMENT OF STEEL REINFORCEMENT:

- A. Place all steel reinforcement before concrete is cast in accordance with approved erection drawings, ACI 117, Chapters 7 and 12 of ACI 318, and the CRSI Manual of Standard Practice.
- B. Remove oil, mill scale, pitting, mud, loose rust, ice, and other materials that would reduce bond from bars before placing.
- C. Tie securely with 16 gage (1.6 mm) or larger annealed iron wire.
- D. Place to maintain concrete cover to conform to ACI 117 and Chapter 7 of ACI 318, unless otherwise indicated.
- E. Splice steel where indicated. Splices shall be in full contact and shall conform to Chapter 12 of ACI 318.
- F. Lap welded wire reinforcement in accordance with Section 12.19 of ACI 318, but not less than the length of one mesh plus 2 inches (50 mm).
- G. Do not bend bars embedded in hardened or partially hardened concrete without approval from Engineer. If bending is permitted, conform to procedures of ACI 301 unless otherwise prescribed by the governing building code.
- H. Do not weld reinforcing bars unless specifically indicated. Where welding is indicated, provide bars conforming to ASTM A706/A706M and comply with AWS D1.4.

END OF SECTION 032000

SECTION 033000 – CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes concrete and related items.

1.03 RELATED WORK SPECIFIED ELSEWHERE:

- A. Section 031000 - Concrete Formwork.
- B. Section 032000 - Concrete Reinforcement.
- C. Section 031550 - Vapor Retarder.
- D. Section 099000 - Protective Coatings.

1.04 REFERENCE STANDARDS:

- A. Comply with the provisions of the following codes, specifications, and standards, except as otherwise indicated.
 - 1. American Concrete Institute (ACI):
 - a. 301 - Specifications for Structural Concrete.
 - b. 318 - Building Code Requirements for Structural Concrete.
 - c. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - B. Applicable Standards Where Referenced Herein:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. C31/C31M - Practice for Making and Curing Concrete Test Specimens in the Field.
 - c. C33 - Concrete Aggregates.
 - d. C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - e. C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - f. C42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - g. C88 - Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - h. C94 - Ready-Mixed Concrete.
 - i. C114 - Test Methods for Chemical Analysis of Hydraulic Cement.
 - j. C117 - Test Method for Material Finer than 75 μ (No. 200) Sieve in Mineral Aggregates by Washing.
 - k. C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - l. C142 - Test Method for Clay Lumps and Friable Particles in Aggregates.
 - m. C143 - Test Method for Slump of Hydraulic Cement Concrete.
 - n. C150 - Portland Cement.
 - o. C172 - Practice for Sampling Freshly Mixed Concrete.
 - p. C192/C192M - Practice for Making and Curing Concrete Test Specimens in the Laboratory.
 - q. C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - r. C233 - Test Methods for Air-Entraining Admixtures for Concrete.
 - s. C260 - Air-Entraining Admixtures for Concrete.

SECTION 033000 – CONCRETE: continued

- t. C289 - Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
 - u. C295 - Guide for Petrographic Examination of Aggregates for Concrete.
 - v. C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
 - w. C430 - Test Method for Fineness of Hydraulic Cement by the 45 μ (No. 325) Sieve.
 - x. C494 - Chemical Admixtures for Concrete.
 - y. C566 - Test Method for Total Evaporable Moisture Content of Aggregate by Drying.
 - z. C595/C595M - Blended Hydraulic Cements.
 - aa. C618 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - bb. C1107 - Packaged Dry, Hydraulic Cement Grout (Nonshrink).
 - cc. C1193 - Guide for Use of Joint Sealants.
 - dd. C1315 - Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - ee. D471 - Test Method for Rubber Property - Liquid Effects.
 - ff. D1751 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Types).
 - gg. D1752 - Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - hh. D2240 - Test Method for Rubber Property - Durometer Hardness.
 - 2. American Concrete Institute (ACI):
 - a. 305.1 - Specification for Hot Weather Concreting.
 - b. 306.1 - Specification for Cold Weather Concreting.
 - c. 308.1 - Standard Specification for Curing Concrete.
 - d. 506.2 - Specification for Shotcrete.
 - 3. Concrete Plant Manufacturers Bureau (CPMB):
 - a. 100 - Concrete Plant Standards.
 - b. 102 - Recommended Guide Specifications for Batching Equipment and Control Systems in Concrete Batch Plants.
 - c. Plant Mixer Manufacturers Division (PMMD) 100 - Concrete Plant Mixer Standards.
 - 4. Federal Specification (FS):
 - a. SS-S-200 - Sealants, Joint: Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement.
 - b. TT-S-227 - Sealing Compound: Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).
 - 5. National Bureau of Standards (NBS) Specifications for Scales.
 - 6. Truck Mixer Manufacturers Bureau (TMMB):
 - a. Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Include, but not limited to, product data and Shop Drawings of the following:
 - 1. Cementitious materials.
 - 2. Nonshrink grouts.
 - 3. Admixtures.
 - 4. Bonding agents.
 - 5. Curing agents.
 - 6. Expansion joint materials.

SECTION 033000 – CONCRETE: continued

7. Joint sealants.
8. Waterstops, submit manufacturers test data for chemical resistance.
- C. Mill Certificates:
 1. Submit to Engineer a minimum of one copy for each cement shipment.
- D. Concrete Mix Design Proportions:
 1. Submit as specified in PART 2, Paragraph 2.01.D. - Mix Proportions, this Section.
 2. Submit for each mix design, including aggregate gradation data.
 3. Resubmit for any change in each mix design.
- E. Production Test Reports: Submit as specified in DIVISION 01 and PART 2, Paragraph 2.01.E. - Measurement of Materials, this Section.

1.06 QUALITY ASSURANCE:

- A. Field Testing: Shall be performed by an ACI Concrete Field Testing Technician Grade 1.
- B. Submit qualification records of field testing and finishing technicians prior to placing concrete.

PART 2 - PRODUCTS

2.01 CONCRETE:

- A. Materials:
 1. Cementitious Materials: Portland cement alone or in combination with one more of the materials listed below.
 - a. Portland Cement ASTM C150, Type I/II.
 - (1) Use one brand of cement throughout the Project unless otherwise approved by Engineer.
 - b. Fly Ash: ASTM C618, Class F.
 - c. Slag Cement: ASTM C989, Grade 100 or 120.
 2. Fine Aggregate:
 - a. Conform to ASTM C33.
 - b. Approved service record of 3 years with a history indicating that the fine aggregate is not chemically reactive.
 - c. For a new fine aggregate source, or when 3 years' approved service records are not available, or when the service records are unacceptable; the aggregate shall be evaluated for potential reactivity. Aggregate must be considered innocuous in accordance with petrographic examination by ASTM C295 and tests conforming to ASTM C289.
 - d. Fine aggregate considered deleterious or potentially deleterious shall not be used without approval.
 - e. Maintain fine aggregate free of ice and frozen lumps.
 - f. Fineness modulus shall be between 2.3 and 3.1.
 3. Coarse Aggregate:
 - a. Conform to ASTM C33.
 - (1) Limits for deleterious substances and physical property requirements shall conform to Table 4 and applicable class designation 5S, 5M, or 1N.
 - b. Approved service record of 3 years with a history indicating that the coarse aggregate is not chemically reactive.
 - c. For a new coarse-aggregate source, when 3 years' approved service records are not available, or when the service records are unacceptable; the aggregate shall be evaluated for potential reactivity. Aggregate must be considered innocuous in

SECTION 033000 – CONCRETE: continued

- accordance with petrographic examination by ASTM C295 and tests conforming to ASTM C289.
- d. Coarse aggregate considered deleterious or potentially deleterious shall not be used without approval.
 - e. Blast furnace slag will not be permitted for use as coarse aggregate.
 - f. Maintain coarse aggregate free of ice and frozen lumps.
 - g. Grading Requirements:
 - (1) Size No. 57, from 1-inch (25-mm) to No. 4 (4.75-mm) sieve for all concrete unless otherwise specified.
4. Mixing Water:
 - a. Only potable water will be acceptable.
5. Admixtures:
 - a. Water-Reducing Type:
 - (1) Conform to ASTM C494, Type A.
 - (2) Conform to manufacturer's recommendations for use.
 - (3) Technical assistance of the manufacturer's field representative shall be furnished upon request.
 - b. Air-Entraining Type:
 - (1) Conform to ASTM C260.
 - (2) Conform to manufacturer's recommendations for use.
 - (3) Technical assistance of the manufacturer's field representative shall be furnished upon request.
 - (4) Testing of air-entraining admixtures shall conform to ASTM C233.
 - c. Other Admixtures: Use only with Engineer's written concurrence.
 - (1) Water-Reducing and Retarding Type: Conform to ASTM C494, Type D.
 - (2) High-Range, Water-Reducing Admixture: Conform to ASTM C494, Type F.
 - (3) High-Range Water-Reducing and Retarding Admixture: Conform to ASTM C494, Type G.
 - d. Admixtures shall not contain any chloride ions.
 - e. Storage: Admixtures shall be stored in such a manner as to avoid contamination, evaporation, freezing, temperature changes, settling, or any damage which would adversely affect their characteristics.
- B. Laboratory Testing of Materials for Use in Concrete:
 - 1. An approved independent testing laboratory shall be selected and paid by Contractor to perform all required laboratory tests of materials proposed for use in the production of concrete and to determine mix proportions when laboratory trial batches are required.
 - 2. Contractor shall deliver representative Samples of all proposed concrete materials to the laboratory for the following testing:
 - a. Fine Aggregate:
 - (1) ASTM C33.
 - (2) ASTM C40.
 - (3) ASTM C88.
 - (4) ASTM C117.
 - (5) ASTM C136.
 - (6) ASTM C142.
 - (7) Fineness modulus.
 - b. Coarse Aggregate:
 - (1) ASTM C33.
 - (2) ASTM C88.

SECTION 033000 – CONCRETE: continued

- (3) ASTM C136.
 - (4) ASTM C142.
 - c. Air-entraining admixture shall be tested conforming to ASTM C233.
 - 3. The laboratory test results shall be part of the design mix submittal specified in this PART 2, Paragraph 2.01.D. - Mix Proportions.
- C. Concrete Qualities Required:
 - 1. Compressive Strength:
 - a. Minimum 28-day compressive strength = 4,500 psi (31 026 kPa) for all construction unless otherwise indicated.
 - b. Minimum 28-day compressive strength = 2,000 psi (13 789 kPa) for fill concrete and seal coats.
 - c. Compressive-strength determinations shall be made from 6-inch (150-mm) diameter by 12-inch (300-mm) long concrete cylinders tested in accordance with ASTM C39.
 - 2. Slump of concrete shall be between 2 inches (50 mm) and 4 inches (100 mm) as tested in accordance with ASTM C143.
 - 3. Air Content:
 - a. 6% \pm 1.5% unless otherwise indicated or specified.
 - b. 3% maximum for all concrete receiving steel-troweled finish.
 - c. Per manufacturer's recommendations for concrete receiving a topping, coloring, coating, or surface hardener.
 - d. Testing shall be in accordance with ASTM C231.
 - 4. Water-Cement Ratio:
 - a. In addition to the aforementioned requirements, water-cement ratios shall be limited as follows:
 - (1) 0.40 for all concrete unless otherwise specified.
- D. Mix Proportions:
 - 1. Concrete shall be homogeneous, readily placeable, uniformly workable, and finishable; proportioned to conform to ACI 211.1.
 - 2. Mix proportions for all concrete, unless otherwise specified, shall be selected preferably on the basis of field experience; but in the case where sufficient or suitable strength test data is not available, concrete shall be proportioned on the basis of laboratory trial mix design.
 - a. Field experience using test results within the preceding year, with the materials and plant to be employed may be the basis of mix proportioning, provided that not less than 30 consecutive satisfactory compressive-strength tests on concrete using the proposed materials with a similar mix are available. A compressive-strength test is defined as the average 28-day compressive strength of two companion cylinders made conforming to ASTM C172 and ASTM C31 and tested conforming to ASTM C39.
 - (1) The standard deviation of compressive-strength tests shall be computed as a basis for design of the mix. The design average compressive strength shall exceed the specified strength by at least:
 - (a) 400 psi (2760 kPa) if standard deviation is less than 300 psi (2070 kPa).
 - (b) 550 psi (3800 kPa) if standard deviation is 300 to 400 psi (2070 to 2760 kPa).
 - (c) 700 psi (4830 kPa) if standard deviation is 400 to 500 psi (2760 to 3450 kPa).

SECTION 033000 – CONCRETE: continued

- (d) 900 psi (6200 kPa) if standard deviation is 500 to 600 psi (3450 to 4140 kPa).
- (e) 1,200 psi (8275 kPa) if standard deviation is greater than 600 psi (4140 kPa).
- (2) Submit the following test data to Engineer for approval prior to placing concrete:
 - (a) Fine Aggregate:
 - 1). ASTM C33.
 - 2). ASTM C40.
 - 3). ASTM C88.
 - 4). ASTM C117.
 - 5). ASTM C136.
 - 6). ASTM C142.
 - 7). Fineness modulus.
 - (b) Coarse Aggregate:
 - 1). ASTM C33.
 - 2). ASTM C88.
 - 3). ASTM C136.
 - 4). ASTM C142.
 - (c) Cement:
 - 1). Mill certificate.
 - 2). ASTM C430.
 - (d) Concrete:
 - 1). Fine and coarse aggregate, water and cement sources.
 - 2). Mix proportions, slump and air content.
 - 3). Data on 30 consecutive satisfactory compressive strength tests and standard deviation calculations.
- b. Laboratory Trial Batch: When laboratory trial batches are used as a basis for determining mix proportions, all such Work shall be performed by the laboratory as specified in PART 2, Paragraph 2.01.B. - Laboratory Testing of Materials for Use in Concrete, this Section.
 - (1) Laboratory trial batches shall be used to establish a water-cement ratio, compression-strength curve with at least three points, each representing the strength of a separate trial batch. At least one point shall be above and one below the strength required. Each point on the curve shall represent the average of at least three cylinders tested at 28 days or an earlier age when approved by Engineer. The slump and air content shall be at the maximum limits specified in PART 2, Paragraph 2.01.C. - Concrete Qualities Required, this Section.
 - (2) A point on the water-cement ratio, compressive-strength curve shall be selected that will provide an average compressive strength at least 1,200 psi (8275 kPa) greater than the specified minimum strength.
 - (3) Submit the following test data to Engineer for approval prior to placing concrete.
 - (a) Fine Aggregate:
 - 1). ASTM C33.
 - 2). ASTM C40.
 - 3). ASTM C88.
 - 4). ASTM C117.

SECTION 033000 – CONCRETE: continued

- 5). ASTM C136.
- 6). ASTM C142.
- 7). Fineness modulus.
- (b) Coarse Aggregate:
 - 1). ASTM C33.
 - 2). ASTM C88.
 - 3). ASTM C136.
 - 4). ASTM C142.
- (c) Cement:
 - 1). Mill certificate.
 - 2). ASTM C430.
- (d) Concrete:
 - 1). Fine and coarse aggregate, water and cement sources.
 - 2). Laboratory mix proportions, slump and air content.
 - 3). Water-cement ratio, compressive-strength curve.
3. Prior to placing any concrete, the laboratory selected by Contractor shall report the results of the testing and mix designs to the following:
 - a. Engineer, Kansas City Office (one copy).
 - b. Resident Project Representative, Field Office (one copy).
 - c. Contractor (copies as required).
 - d. Concrete Supplier (copies as required).
- E. Measurement of Materials:
 1. General Requirements:
 - a. Conform to ACI 304R.
 - b. Beam or springless dial-type scale conforming with NBS - "Specifications for Scales."
 - c. Volumetric measurement of water shall be performed with an approved automatic valve.
 2. Concrete Plant Scale Accuracy and Calibration Frequency:
 - a. The concrete plant scales shall be accurate to $\pm 0.4\%$ of the capacity of the scale.
 - b. The scales shall be calibrated at intervals as specified in PART 3, Article 3.09 - Testing, this Section.
 3. Individual Batch Accuracy:
 - a. Cement: $\pm 1.0\%$.
 - b. Water: $\pm 1.0\%$ by volume or weight.
 - c. Aggregates: $\pm 2.0\%$.
 - d. Admixtures: $\pm 3.0\%$ by volume or weight.
 - e. Fly Ash: $\pm 1.0\%$.
- F. Mixing and Delivery:
 1. Conform to ACI 304R.
 2. Cement temperature, when added to mix, shall not exceed 170°F (77°C).
 3. Adjust the amount of mix water to compensate for the moisture content of the aggregates.
 4. Concrete Plant:
 - a. Conform to "Concrete Plant Mixer Standards" of the Plant Mixer Manufacturers Division, Concrete Plant Manufacturers Bureau, and "Concrete Plant Standards" of the Concrete Plant Manufacturers Bureau.
 - b. Charge with 5% to 10% of the mixing water both in advance and after the addition of aggregates and cement.
 - c. Charge with remaining water uniformly with the other materials.

SECTION 033000 – CONCRETE: continued

- d. Avoid charging in excess of manufacturer's rating.
- e. Discharge mixed concrete completely prior to recharging.
- f. Mixing Time:
 - (1) Start immediately when all ingredients, except the last of the water, are in the mixer.
 - (2) Minimum mixing time shall conform with mixer manufacturer's instructions, but not be less than the following:

| Capacity of Mixer <u>Cubic Yards</u> | Minimum Time <u>of Mixing</u> |
|---|----------------------------------|
| 1 or less..... | 1 minute |
| 2..... | 1 minute, 15 seconds |
| 3..... | 1 minute, 30 seconds |
| 4..... | 1 minute, 45 seconds |
| 5..... | 2 minutes |
| 6..... | 2 minutes, 15 seconds |

Add 15 seconds' mixing time for each additional cubic yard of concrete.

- 5. Mixing of Concrete at Plant Off Jobsite:
 - a. Mix concrete in central mixer or truck mixer. Transport in truck mixer turning at agitation speeds only.
 - b. Water added to concrete having a slump below the specified minimum shall be at Contractor's risk. If the water added produces a slump greater than the specified maximum, the concrete will be rejected. If water is added, the concrete shall be remixed for a minimum of 25 revolutions. Water shall not be added after the truck mixer has begun to discharge concrete.
 - c. Truck mixer shall conform to "Truck Mixer, Agitator, and Front Discharge Concrete Carrier Standards" of the Truck Mixer Manufacturers Bureau.
 - d. Ready-mixed concrete shall be produced and delivered conforming to ASTM C94 as applicable.
 - e. Contractor shall furnish Owner with a concrete delivery ticket for each load of concrete. The ticket shall have the following information recorded:
 - (1) Serial number of ticket.
 - (2) Time batched.
 - (3) Time arrived on jobsite.
 - (4) Amount of concrete (by volume).
 - (5) Mix number.
 - (6) Amount of all water added at jobsite by Contractor.
 - (7) Name of ready-mix batch plant.
 - (8) Date.
 - (9) Truck number.
 - (10) Name of purchaser.
- 6. Plant and truck mixer uniformity shall be tested according to ASTM C94. Frequency of tests shall be as specified in PART 3, this Section.

2.02 GROUT:

A. Grout for Dry Packing:

- 1. Volume: 1 part Portland cement to 2 parts sand.
- 2. Keep water to a minimum as required for placing by the dry packing method.

SECTION 033000 – CONCRETE: continued

3. Place after the mixed grout has been allowed to stand for 2 hours.
 4. The sand and cement shall be as specified for concrete.
- B. Flowable Nonshrinking Grout:
1. Required for setting equipment recommended by the manufacturer to be set with nonshrinking grout, and in other places indicated.
 2. Grout shall be nonmetallic and conform to ASTM C1107.
 3. Prepare and place conforming to manufacturer's printed instructions.
 4. For equipment bases, the concrete surfaces shall be grit blasted or roughened with a chipping hammer prior to grouting. The foundation plates shall be cleaned of any grease, oil, paint, primers, or epoxy coatings.
- C. Grout for Bonding:
1. Proportion (by weight): 1 part cement to 1-1/2 parts sand.
 2. Keep water to a minimum.
- 2.03 BONDING AGENT:
- A. Provide moisture-insensitive, epoxy-resin bonding agent conforming to ASTM C881, Type V.
- 2.04 CONCRETE ACCESSORIES:
- A. Chemical Resistant Waterstop:
1. 6-inch ribbed centerbulb equal to one of the following:
 - a. Westec – Envirostop TPER, Style 618.
 - b. Or approved equal.
 2. Provide factory fabricated waterstop corner transitions and intersections leaving only straight butt joint splices for the field.
 3. Waterstops shall be provided with factory-installed hog rings at 12-inch centers along each flange.
 4. Use for all locations unless otherwise specified.
- B. Expansion Joints:
1. Expansion Joint Filler: Preformed asphalt-impregnated fiber of thickness indicated and conforming to ASTM D1751. Use where indicated.
 2. Bond Breaker: Polyethylene tape or other plastic tape as recommended by sealant manufacturer.
 3. Sealant Backer Rod: Provide closed cell backer rod or other backing material as recommended by sealant manufacturer.
 4. Joint Sealants:
 - a. Multi-component sealant as follows:
 - (1) Joint Sealant - General Use:
 - (a) BASF Building Systems: Sonneborn Sonolastic NP 2 (vertical use) and Sonolastic SL 2 (horizontal use).
 - (b) Epoxy Systems Products Company: Product #11.
 - (c) Euclid Chemical Company: Eucolastic II.
 - (d) Pecora Corporation: NR-200, Dynatred.
 - (2) Joint Sealant - Potable Water Treatment and Storage Facilities:
 - (a) Sika Corporation: Sikaflex-2c NS.

2.05 CURING AGENT:

- A. Apply to all concrete surfaces unless otherwise indicated or specified.
- B. Curing agent shall conform as follows:

SECTION 033000 – CONCRETE: continued

1. ASTM C309, Type 1: Use where concrete surface is not exposed to direct sunlight after placement.
 2. ASTM C309, Type 1-D: Use where slabs are exposed to direct sunlight for a period of seven days minimum after placement. Curing and sealing agent with fugitive dye shall be readily distinguishable upon the concrete surface for at least four hours after application but shall be inconspicuous within seven days after application.
 3. ASTM C309, Type 2: Use as specified in PART 3, Article 3.05 - Hot Weather Concreting, this Section.
- C. Curing compound used on floors to be sealed, painted, tiled, topped, dampproofed, waterproofed, or covered with resilient floor covering shall be guaranteed not to interfere with application of sealer, paint, tile mortar, or tile adhesive after a 28-day curing period.
- D. Curing compound shall be VOC compliant with a maximum VOC content of 2.9 lbs./gal (350 g/L), or less where Project location regulations are more stringent.

2.06 CONCRETE FLOOR CURING AND SEALING AGENT:

- A. Apply to all interior concrete floor surfaces subject to vehicle or pedestrian traffic.
- B. Curing and sealing agent shall conform as follows:
1. ASTM C1315, Type I, Class A: Use where slabs are not exposed to direct sunlight after placement.
 2. ASTM C1315, Type I, Class A with Fugitive Dye: Use where slabs are exposed to direct sunlight for a period of seven days minimum after placement. Curing and sealing agent with fugitive dye shall be readily distinguishable upon the concrete surface for at least four hours after application but shall be inconspicuous within seven days after application.
 3. ASTM C1315, Type II, Class A: Use as specified in PART 3, Article 3.05 - Hot Weather Concreting, this Section.
- C. Apply as soon as possible and in conformance with manufacturer's written instructions.

PART 3 - EXECUTION

3.01 PREPARATION FOR CONCRETE PLACEMENT:

- A. Openings Through Concrete: Provide openings through concrete as indicated and for the proper installation of all equipment, piping, wiring, ductwork and similar items, installed under this Contract.
- B. Installation of Embedded Items:
1. Provide for accurate installation of embedded items installed under this Contract.
 2. Securely fix floor drains in place to prevent flotation while placing concrete. Uniformly and accurately slope finish floor slab toward the drains.
 3. Embedded items shall be as indicated or specified, or as selected by Contractor and approved by Engineer.
 4. During cold weather, protect pipe sleeves, shear pockets, and blockouts from moisture which may freeze, expand, and crack the sleeve, pocket, or blockout and concrete structure.
 5. Grease or tape anchor bolt threads to protect from concrete splatter.
- C. Installation of Joints:
1. Construction Joints:
 - a. Location:
 - (1) Locate joints, which are not indicated or specified, in conformance with ACI 318.

SECTION 033000 – CONCRETE: continued

- (2) Obtain Engineer's approval of joints located by Contractor prior to preparation of reinforcing steel drawings.
 - b. Preparation and Installation:
 - (1) Clean and break laitance or other foreign material from bonding surface.
 - (2) Tighten forms remaining in place (where applicable) to prevent seepage between forms and hardened concrete.
 - (3) Provide waterstops and shear keys as indicated or specified and as required in any new construction joint requested by Contractor.
 - c. Waterstops:
 - (1) Install in all construction joints where indicated.
 - (2) Install conforming to manufacturer's printed instructions. All joints and splices of waterstop shall be 100% fused. Use thermostatically controlled splicing iron as recommended by manufacturer.
 - 2. Expansion Joints:
 - a. Install filler, backer rod and sealant in strict conformance with manufacturer's written instructions.
 - b. Reinforcing steel shall not extend through expansion joints unless indicated otherwise.
 - c. Attach rigid joint filler to the face of the joint prior to placing adjacent concrete. The filler shall occupy the entire width of the joint.
 - d. Install sealant backer rod for sealant except where indicated to be omitted. Install bond breaker where indicated.
 - e. Clean joints surfaces immediately before application of sealant.
 - f. Install joint sealants to conform to ASTM C1193. Tool sealants to provide smooth, uniform bead with a slightly concave surface, eliminate air pockets, and insure sealant contact and adhesion with sides of joint.
 - g. Protect joints from moisture and ice during freezing.
- D. Cutting and Bonding to Existing Concrete:
 - 1. Cutting Existing Concrete:
 - a. Use methods and equipment that will avoid damage to adjacent parts of the structure from heavy blows or vibration.
 - b. Cut existing concrete with power concrete saw where possible to prevent spalling and chipping and to form neat, straight edge.
 - c. Remove all loose or cracked concrete resulting from cutting existing concrete, leaving only sound, undamaged concrete adjacent to new Work.
 - d. Leave access opening edges with a neat, true grout surface to the opening size indicated.
 - e. Cut reinforcing steel with sufficient length remaining (approximately 38 bar diameters) for bending and lapping into new construction.
 - 2. Bonding to Existing Concrete:
 - a. Roughen concrete to 1/4-inch (6-mm) amplitude by use of a pneumatic chipping hammer or other approved means.
 - b. Thoroughly clean the concrete surface and apply the bonding agent in accordance with manufacturer's written instructions.

3.02 PLACING OF CONCRETE:

- A. Conventional Placing:
 - 1. General Requirements:
 - a. Conform to ACI 304R.

SECTION 033000 – CONCRETE: continued

- b. Bonding surfaces, including reinforcement, shall be clean, free of laitance and foreign materials.
 - c. Face horizontal bonding surfaces with 1-inch (25-mm) thick coat of fresh "grout for bonding." Wet all other surfaces.
 - d. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavation and forms.
 - e. Do not place concrete that has partially hardened or has been contaminated by foreign materials.
 - f. Prevent mud or foreign materials from entering the concrete or forms during placement operations.
2. Conveying:
- a. Convey concrete from the mixer and deposit in place by methods which will prevent the segregation or loss of materials.
 - b. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.
 - c. Aluminum conveying equipment shall not be used.
3. Depositing:
- a. Place concrete in continuous horizontal lifts not to exceed 2 feet (600 mm), and place concrete against bulkheads and keyways at vertical joints.
 - b. Maximum free drop of concrete and grout for bonding shall be 5 feet (1.5 meters), in walls 10 inches (250 mm) or less in thickness, with 1-foot (300-mm) additional drop allowed for each inch (25 mm) of wall thickness over 10 inches (250 mm), with a maximum drop of 10 feet (3 meters).
 - c. When vapor barrier is used, keep lapped joints closed and take precautions to avoid puncturing the barrier.
4. Consolidation of Concrete:
- a. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - b. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in good operating condition.
 - c. Vibrate concrete only until the concrete is thoroughly consolidated and the voids filled, as evidenced by the leveled appearance of the concrete at the exposed surface and the embedment of the surface aggregate.
 - d. Insert internal vibrators vertically to the full depth of the layer being placed and into the previous layer. Do not drag vibrators through the concrete. Insert and withdraw vibrator slowly with the vibrator running continuously so that no hole will be left in the concrete. Do not flow concrete from one location to another by use of a vibrator.
 - e. Consolidate concrete layer to full depth when using a surface vibrator. Use thinner layers or a more powerful vibrator if necessary to achieve complete consolidation.
 - f. Use form vibrators only where sections are too thin or where sections are inaccessible for internal vibrators.
5. Time Requirements:
- a. Place concrete at a sufficient rate to assure that lifts below have not taken initial set before fresh concrete is deposited.
 - b. Place concrete within 45 minutes after mixing. This period may be extended to 1 hour and 30 minutes provided that the combined air temperature, relative

SECTION 033000 – CONCRETE: continued

humidity, and wind velocity are such that the plasticity of the fresh concrete is satisfactory for placement and consolidation, and that the specified mixing water is not exceeded. Concrete which has partially set shall not be retempered but shall be discarded.

B. Placing Concrete at Joints:

1. Bed horizontal joints with 1 inch (25 mm) of grout for bonding.
2. Take precautions to ensure tight, well-bonded construction joints with no air pockets or voids.
3. Take special precautions to avoid bending or displacing waterstop while placing concrete around it.
4. Delay construction at a joint a minimum of 16 hours where placement is continued past joint, except where otherwise indicated.

3.03 FINISHING:

A. Unformed Surfaces:

1. Screed Finish:
 - a. Use as first stage for all concrete finishes.
 - b. Use as final finish on surfaces that will be covered by additional concrete, grout placement, or mortar setting bed except as otherwise specified.
 - c. Immediately after screeding, use a wood float, darby, or bullfloat to eliminate high and low spots and to embed large aggregate. This shall be done in a manner to produce even, uniform surfaces so that surface irregularities do not exceed 3/8 inch in 10 feet (9 mm in 3 meters) when used as final finish.
2. Floated Finish:
 - a. Use as second stage of broomed, troweled, or magnesium-troweled finish.
 - b. Float with mechanical float. Hand floating will be permitted only in areas inaccessible to mechanical float.
 - c. On surfaces not to receive troweled or magnesium-troweled finish, finish with wood or cork float after mechanical floating to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet (3 mm in 3 meters), except at floor drains.
3. Broomed Finish:
 - a. Use as final finish on all outdoor slabs including pavements, sidewalks, and loading docks.
 - b. After floated finish, draw a stiff bristle broom across the surface making uniform corrugations, perpendicular to the direction of traffic, not more than 1/16 inch (1.6 mm) deep.
4. Troweled Finish:
 - a. Use as final finish on inside floors and on all other unformed surfaces not otherwise indicated or specified.
 - b. Trowel with mechanical steel trowel to obtain a smooth, dense finish. Hand steel trowel shall be used in areas not accessible by mechanical trowel. The final troweling shall be done after the concrete has become hard enough so that no mortar adheres to the edge of trowel and a ringing sound is produced as the trowel passes over the surface.
 - c. Do not trowel before surface water has evaporated or has been removed with a squeegee.
 - d. Finish to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet (3 mm in 3 meters), except at floor drains.

SECTION 033000 – CONCRETE: continued

- e. Do not add sand or cement to the floor surface.
- 5. Magnesium-Troweled Finish:
 - a. Perform as specified in PART 3, Paragraph 3.03.A.4. - Troweled Finish, this Section, except use a magnesium trowel by hand instead of a steel trowel to obtain a dense, but not slick, finish.
 - b. Use where floor will receive protective coating after curing.
- 6. Contraction Joints:
 - a. Locate as indicated.
 - b. Maintain true alignment with straightedge.
 - c. Joints shall be grooved except where sawed joints are indicated.
 - (1) Slab on grade joints shall be sawed.
 - d. Grooved Joints:
 - (1) Perform during the finishing process.
 - (2) Width of groove shall not exceed 1/4 inch (6 mm).
 - (3) Depth of groove shall be at least 1 inch (25 mm).
 - e. Sawed Joints:
 - (1) Cut joints with power blade as soon as concrete surface is firm enough to resist tearing or damage by the blade and before random shrinkage cracks can occur. (Usually required 4 to 12 hours after finishing.)
 - (2) Make joints approximately 1/8 inch (3 mm) wide with depth equal to 1/4 the slab thickness unless otherwise indicated.
 - (3) Seal where indicated with the same type sealant specified for expansion joint sealant.
- 7. Floor Flatness and Levelness:
 - a. Applicable for steel and magnesium troweled finish floors, and other floors as indicated or specified.
 - b. Finish to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet (3 mm in 3 meters), except at floor drains.
 - c. All slabs on grade not meeting the above minimum tolerance tests shall be removed and replaced at Contractor's expense.
- B. Formed Surfaces:
 - 1. Repair surface defects as specified in PART 3, Paragraph 3.03.C. - Repair of Defective Surfaces, this Section.
 - 2. Burlap Finish:
 - a. Apply burlap surface treatment to the following formed surfaces:
 - (1) Concrete exposed to public view.
 - (2) Concrete that is to be painted.
 - b. Remove forms as soon as permitted in accordance with Section 031000.
 - c. Wet and fill all voids using mortar with the same sand-cement ratio as original concrete. Blend with white cement to match concrete color.
 - d. Strike off all excess mortar flush with the surface using a burlap or canvas cloth with a circular motion.
 - e. Remove all rough spots and rub with cloth to leave a surface of uniform texture and appearance.
 - f. Finish shall result in a coating of mortar that will fill all small voids and air holes, leaving a smooth surface.
 - g. Cure as specified in this PART 3, Article 3.04 - Curing, this Section.
- C. Repair of Defective Surfaces:

SECTION 033000 – CONCRETE: continued

1. Defined as any concrete surface showing misalignment, rock pockets, poor joints, holes from ties, voids, honeycomb, or any other defective area.
2. Repairing:
 - a. Repair as soon as forms have been removed.
 - b. Chip surface back to minimum depth of 1/2 inch (13 mm), chip edges perpendicular to surface, prewet depression and brush with neat cement immediately before patching.
 - c. Patch surfaces using stiff mortar with same sand-cement ratio as original concrete and with minimum water for placing. Blend with white cement to match concrete color.
 - d. Compact mortar into depressions so that after curing, hole is filled and mortar is flush with surface. Use hammer and ramming rod for compacting the holes.
 - e. Moist-cure for 3 days or use curing compound.
 - f. Engineer shall be notified of areas containing defects or where reinforcing steel is exposed, prior to determination of repair method.

3.04 CURING:

- A. Cure concrete by one of the following methods in accordance with ACI 308.1:
 1. Leaving in forms for a minimum of 7 days. Keep formwork wet to prevent drying of concrete surfaces.
 2. Using one coat of a liquid membrane forming compound as specified. Apply immediately after removal of forms (which have been continuously wet); or in case of a slab, after the concrete has been finished and is hardened sufficiently to walk on.
 3. Curing of concrete during hot or cold weather shall conform to PART 3 - Hot Weather Concreting and Cold Weather Concreting, this Section.

3.05 HOT WEATHER CONCRETING:

- A. Comply with ACI 305.1, ACI 301 and as follows:
 1. When the temperature is 90°F (32°C) or above.
 2. When the temperature is likely to rise above 90°F (32°C) within the 24-hour period after concrete placement.
 3. When there is any combination of high air temperature, low relative humidity, and wind velocity which would impair either concrete strength or quality.
- B. Concrete shall have a maximum temperature of 90°F (32°C) during placement.
- C. Dampen subgrade and forms with cool water immediately prior to placement of concrete.
- D. Protect freshly placed concrete immediately after placement so that the rate of evaporation does not exceed 0.2 pound per square foot (1.0 kg per square meter) per hour.
- E. Protect concrete with suitable insulation if rapidly decreasing nighttime temperatures occur, which would cause thermal shock to concrete placed during warm daytime temperatures.
- F. Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.
- G. Begin curing unformed surfaces immediately after finishing and continue for 24 hours. Curing shall consist of application and maintenance of water-saturated material to all exposed surfaces; horizontal, vertical, and otherwise. After the 24-hour interval, continue curing using one of the following methods:
 1. Moist curing for 6 days.
 2. Application of one coat of curing compound as specified.
 3. Application and maintenance of curing paper or heat-reflecting plastic sheets for 6 more days.

SECTION 033000 – CONCRETE: continued

- H. Begin curing formed concrete immediately after placing. Curing shall consist of keeping forms continuously wet for 24 hours. Thereafter, continue curing using one of the following methods:
 - 1. Loosen forms and position soaker hose so that water runs down along concrete surfaces. Continue for 6 days.
 - 2. Strip forms and apply curing compound as specified. Do not allow concrete surfaces to dry prior to application of curing compound.

3.06 COLD WEATHER CONCRETING:

- A. Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- B. When average high and low temperature is expected to fall below 40°F (4.4°C) for three successive days, maintain delivered concrete mixture temperature range required by ACI 301.
- C. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- D. Calcium chloride will not be permitted as a concrete accelerator or to thaw frozen subgrade prior to concrete placement.
- E. Monitor temperature of concrete in place at corners or edges of formwork as applicable to evaluate and verify the effectiveness of the protection provided.
- F. Air Heaters:
 - 1. Do not expose concrete to carbon monoxide or carbon dioxide fumes from heaters or engines.
 - 2. Oil- or coke-burning salamanders will not be permitted.
 - 3. Approved heaters shall be indirect with flue systems directing exhaust gases outside the enclosure area.
 - 4. Personnel shall be present at all times to maintain safe, continuous operation of heating system.
- G. Control temperature and humidity of protected concrete so that excessive drying of concrete surfaces does not occur.
- H. Cure the concrete in accordance with ACI 306.1.

3.07 LOW-STRENGTH CONCRETE:

- A. Low-Strength Concrete:
 - 1. Defined as either:
 - a. Concrete whose average, of any sets of three consecutive 28-day compressive strength tests, is below the required 28-day strength.
 - b. Concrete whose individual 28-day strength test (average of two cylinders) is more than 500 psi (3450 kPa) below the required 28-day strength.
 - 2. Should concrete meet either definition of low-strength concrete as a minimum, the Contractor shall take the following steps:
 - a. Increase the cement content. The increase shall be based on a statistical evaluation of the strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature as follows:
 - (1) If sufficient concrete has been furnished to accumulate 30 tests, these should be used to establish a new target average strength in accordance with ACI 318, Section 5.3.
 - (2) If less than 30 tests have been made, the new target average strength should be at least as great as the average strength used in the initial selection of the mix proportions. Increase the target average strength based on a statistical

SECTION 033000 – CONCRETE: continued

evaluation of the available strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature. If the statistical average equals or exceeds the initial mix-design level, a further increase in the average level is required.

- b. Remove and replace with acceptable concrete when the quality and location of the low-strength concrete is such that Engineer considers the strength or durability of the structure is impaired and so orders.
3. Low-strength concrete shall be considered defective Work as defined in General Conditions.
- B. Potentially Low-Strength Concrete: Defined as concrete whose 7-day test (average of two cylinders) is less than 70% of the specified minimum 28-day compressive strength.
- C. Construction delays caused by low-strength or potentially low-strength concrete shall not relieve Contractor from responsibility for late completion even though extensions of time may be granted.

3.08 MISCELLANEOUS CONCRETE ITEMS:

- A. Equipment Bases:
 1. Construct equipment bases, pads, and foundations as indicated or, when not indicated, conforming to equipment manufacturer's requirements.
 2. Reinforce conforming to typical detail unless otherwise indicated.
 3. Equipment bases shall include concrete, reinforcing steel, form work as required, and anchor bolts. Place grout for equipment installed under this Contract.
 4. Finish top area of bases between anchor bolts and forms with a troweled finish.

3.09 TESTING:

- A. Field Testing of Concrete Plant and Mixing Trucks:
 1. The concrete plant shall be inspected and tested to ensure conformance with ACI 304R and the "Concrete Plant Standards of the Concrete Plant Manufacturers Bureau." The scales shall be calibrated at the initial setup and at 3-month intervals thereafter.
 2. Mixing trucks shall be inspected and tested to ensure conformance with ACI 304R and "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau" of the National Ready-Mix Concrete Association. Tests shall be done at initial setup and every 3 months thereafter.
 3. Submit test reports when requested.
- B. Field Testing of Concrete and Making of Concrete Test Cylinders:
 1. Contractor shall furnish test equipment, test cylinder molds, and certified personnel to perform all required field tests, make the required concrete test cylinders, and deliver test cylinders to the testing laboratory. The prescribed tests shall be made in the presence of or with the concurrence of the Owner.
 2. Field testing personnel shall be on Site throughout placement of concrete.
 3. Concrete sampling for tests and cylinder making shall be done conforming to ASTM C172. Samples shall be taken at random and at the point of truck discharge.
 4. Perform the following tests:
 - a. Moisture content, ASTM C566. Perform this test a minimum of twice a day and adjust the amount of mix water to compensate for the moisture content of the aggregates.
 - b. Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (four cylinders) from each day's placement for each 100 cubic yards (75 cubic meters) or fraction thereof.

SECTION 033000 – CONCRETE: continued

- c. Slump test conforming to ASTM C143. Perform tests on the first batch produced each day, for every 50 cubic yards (38 cubic meters) or fraction thereafter, and with every set of test cylinders. Additional tests shall be run when directed by Engineer.
 - d. Air content test conforming to ASTM C231. Perform for first batch of day and with each set of test cylinders.
 - e. The batch of concrete being tested for slump or air content shall not be placed until acceptable results are obtained.
 - f. Discard concrete used for slump and air tests.
 - g. Perform concrete and air temperature tests for first batch of day and with each set of test cylinders. Additional readings shall be taken when directed by Engineer.
 - h. Any batch of concrete with slump or air content not in conformance with Specifications shall be rejected.
 - i. Furnish slump, air content, and temperature test results to the testing laboratory for inclusion in the cylinder test reports.
- C. Laboratory Testing of Aggregates and Concrete During Construction:
1. An independent testing laboratory will be selected and paid by the Owner to perform the required laboratory tests and statistical evaluations of aggregates and concrete being used in the Work.
 2. Laboratory will cure and test concrete cylinders conforming to ASTM C192 and C39, testing two cylinders at 7 days of age and two at 28 days of age.
 3. Contractor shall have the right to observe all phases of concrete cylinder curing and testing. Should Contractor observe any deviations from the prescribed testing procedures that he considers detrimental to concrete strength test results, he shall immediately notify Owner in writing.
 4. Contractor shall assist laboratory in obtaining Samples of fine and coarse aggregate for testing.
 5. Contractor shall make arrangements with the testing laboratory to receive copies of test reports. The cost of providing a maximum of two copies of each report to the Contractor will be paid by Owner.
 6. Should the test results indicate low strength concrete as defined in PART 3, Article 3.07 - Low-Strength Concrete, this Section, Contractor shall take immediate corrective action.
 7. Should the statistical data indicate an excessive margin of safety, the concrete mix may be modified subject to Engineer's approval.
 8. Should the material tests taken during construction indicate nonconformance with the Specifications, Contractor shall take immediate corrective action.
- 3.10 REPAIR, REPLACEMENT, AND FIELD MODIFICATIONS:
- A. Embedded items and concrete that are misplaced or damaged during construction shall not be repaired, replaced, or field-modified without approval of Engineer.

END OF SECTION 033000

SECTION 034120 - PRECAST CONCRETE SECTIONS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section covers precast, prestressed structural concrete construction, including product design not shown on Contract Drawings, manufacture, transportation, erection, and other related items such as anchorage, bearing pads, storage, and protection of precast concrete.
- B. This Section also includes cast-in-place concrete to develop connections, anchorage, and alignment items as required for erection.
- C. Related Work Specified Elsewhere:
 - 1. Concrete: SECTION 033000.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. Standard Specifications for Highway Bridges.
 - 2. American Concrete Institute (ACI):
 - a. 318 - Building Code Requirements for Structural Concrete.
 - b. SP-66 - Detailing Manual.
 - 3. American Society for Testing and Materials (ASTM):
 - a. A36 - Carbon Structural Steel.
 - b. A47 - Ferritic Malleable Iron Castings.
 - c. A82 - Steel Wire, Plain, for Concrete Reinforcement.
 - d. A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - e. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - f. A185 - Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
 - g. A283/A283M - Low and Intermediate Tensile Strength Carbon Steel Plates.
 - h. A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - i. A325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - j. A416/A416M - Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
 - k. A496 - Steel Wire, Deformed, for Concrete Reinforcement.
 - l. A497 - Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - m. A615/A615M - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - n. A616/A616M - Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
 - o. A617/A617M - Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
 - p. A666 - Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar.
 - q. A706/A706M - Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
 - r. C33 - Concrete Aggregates.
 - s. C150 - Portland Cement.
 - t. C260 - Air-Entraining Admixtures for Concrete.
 - u. C494 - Chemical Admixtures for Concrete.
 - v. C1107 - Packaged, Dry Hydraulic-Cement Grout (Non-Shrink).
 - 4. American Welding Society (AWS):
 - a. D1.1 - Structural Welding Code - Steel.
 - b. D1.4 - Structural Welding Code - Reinforcing Steel.
 - 5. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
 - 6. Department of Defense (DOD):
 - a. Specification for Paint, High Zinc Dust Content, Galvanizing Repair DOD-P-21035.

SECTION 034120 - PRECAST CONCRETE SECTIONS: continued

7. Prestressed Concrete Institute (PCI):
 - a. MNL-116 - Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.
 - b. MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.
- 1.03 SUBMITTALS:
- A. Submit as specified in DIVISION 1.
 - B. Shop Drawings:
 1. Erection Drawings:
 - a. Member piece marks and completely dimensioned size and shape of each member.
 - b. Plans and/or elevations locating and defining all materials furnished by manufacturer.
 - c. Sections and details showing connections, cast-in items, and their relation to the structure.
 - d. Relationship to adjacent material.
 - e. Joints and openings between members and between members and structure.
 - f. Description of all loose, cast-in, and field hardware.
 - g. Field installed anchor location drawings.
 - h. Erection sequences and handling requirements.
 - i. All dead, live, and other applicable loads used in the design.
 - j. Drawings shall be sealed by a registered engineer licensed in the State of Arkansas.
 2. Production Drawings:
 - a. Elevation view of each member.
 - b. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, and related items.
 - c. Lifting and erection inserts.
 - d. Dimensions and finishes.
 - e. Prestress for strand and concrete strengths.
 - f. Estimated cambers.
 - g. Method of transportation.
 - C. Product Design Criteria:
 1. Loadings for Design:
 - a. Initial handling and erection stresses.
 - b. All dead and live loads as specified on the Contract Drawings.
 - c. All other loads specified for member, where applicable.
 2. Design criteria shall state all applicable standards, codes, and specifications for which precast sections are to be designed.
 3. Submit design calculations sealed by a registered engineer licensed in the state of Arkansas.
 - D. Permissible Design Deviations:
 1. Design deviations, supported by complete design calculations and drawings, shall be submitted for approval.
 2. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to the Owner.
 - E. Tests: Submit certified copies of test reports including all data and results of tests performed as required by PCI MNL-116. Submittals shall include, but shall not be limited to, the following:
 1. Cement.
 2. Fine aggregate.

SECTION 034120 - PRECAST CONCRETE SECTIONS: continued

3. Coarse aggregate.
 4. Admixtures.
 5. Curing materials.
- F. Certificates: Submit certificate stating that the manufacturer is a producer member of PCI and that the manufacture participates in the Plant Certification Program.
- 1.04 QUALITY ASSURANCE:
- A. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program. Manufacturer shall be certified at time of bidding. Certification shall be in the following product group(s) and category(ies):
 1. Group C, Category C3.
 2. Group C, Category C4.
 - B. Erector Qualifications: Regularly engaged for at least five years in the erection of precast structural concrete similar to the requirements of this Project.
 - C. Welder Qualifications: In accordance with AWS D1.1.
 - D. Testing: Conform with testing provisions in MNL-116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- 1.05 DESIGN:
- A. Design of units and embedments shall be performed by structural analysis in accordance with ACI 318 or PCI MNL-120, whichever is customary with the manufacturer.
 - B. Structural analysis shall include evaluations of the effects of connections, holes, discontinuities, concentrated loads, and joints.
 - C. Units shall be designed for the load conditions and spans indicated, and any additional loads imposed by openings, work of other trades, concrete topping indicated, and all loading and restraining conditions from fabrication, handling, and erection.
 - D. The sum of the immediate deflection due to live load and additional long-term deflection shall not exceed the deflection limitations indicated.
 - E. The design shall compensate for the weight of the additional topping required by the camber in order to achieve the minimum topping thickness used in the design.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
- A. Delivery and Handling:
 1. Precast concrete members shall be cured prior to delivery to the jobsite.
 2. Precast concrete members shall be lifted and supported during manufacturing, stockpiling, transporting, and reaction operations only at the lifting or supporting point, or both, as shown on the Shop Drawings, and with approved lifting devices. Lifting inserts shall have a minimum safety factor of 4. Exterior lifting hardware shall have a minimum safety factor of 5.
 3. Transportation, site handling, and erection shall be performed with acceptable equipment and methods, and by qualified personnel.
 4. Secure all necessary permits required by affected governing bodies for transportation routes and methods.
 - B. Storage:
 1. Store all units off ground.
 2. Place stored units so that identification marks are discernible.
 3. Separate stacked members by battens across full width of each bearing point.
 4. Stack so that lifting devices are accessible and undamaged.

SECTION 034120 - PRECAST CONCRETE SECTIONS: continued

5. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or III.
- B. Admixtures:
 1. Air-entraining admixtures: ASTM C260.
 2. Water reducing, retarding, accelerating, high range water reducing admixtures: ASTM C494.
 3. Calcium chloride or admixtures containing chlorides shall not be used.
- C. Aggregates: ASTM C33.
- D. Water: Potable.
- E. Reinforcing Steel:
 1. Bars:
 - a. Deformed billet-steel: ASTM A615.
 - b. Deformed low-alloy steel: ASTM A706.
 2. Wire:
 - a. Cold-Drawn Steel: ASTM A82.
 3. Wire Fabric:
 - a. Welded Steel: ASTM A185.
 - b. Welded Deformed Steel: ASTM A497.
 - c. Use mats only.
- F. Strand: Uncoated, 7-wire, strand shall conform to ASTM A416, Grade 250 or 270.
- G. Bolsters, Chairs and Accessories:
 1. Conform to ACI SP-66 and the CRSI Manual of Standard Practice.
 2. Provide all spacers, bolsters, chairs, ties, and other devices necessary to properly space, place, support, and fasten steel reinforcement in place during the concrete placement.
 3. Metal accessories shall be stainless steel or plastic coated where legs will be exposed in finished concrete surfaces.
- H. Anchors and Inserts:
 1. Materials:
 - a. Structural Steel: ASTM A36.
 - b. Malleable Iron Castings: ASTM A47.
 - c. Stainless Steel: ASTM A666.
 - d. Carbon Steel Plate: ASTM A283.
 - e. Bolts: ASTM A307 or A325.
 - f. Deformed Bar Anchors: ASTM A496.
 - g. Welded Headed Studs: AWS D1.1 - Type B.
 2. Finish:
 - a. Shop Primer: Manufacturer's standards.
 - b. Hot Dipped Galvanized: ASTM A153.
 - c. Zinc-Rich Coating: DOD-P-21035, self-curing, one component, sacrificial.
 - d. Cadmium coating.
- I. Grout:
 1. Grout Strength: 5000 psi minimum.
 2. Cement Grout: One part portland cement and 2-1/2 parts sand by volume, and water sufficient for placement and hydration.

SECTION 034120 - PRECAST CONCRETE SECTIONS: continued

3. Nonshrink Grout: Conform to ASTM C1107, Type A.
- J. Bearing Pads:
 1. Chloroprene (Neoprene): Conform to Division II, Section 18 of AASHTO Standard Specifications for Highway Bridges.
 2. Random-Oriented Fiber Reinforced: Shall support a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of the pad.
 3. Duck Layer Reinforced: Conform to Division II, Section 18.10.2 of AASHTO Standard Specifications for Highway Bridges.
 4. Tetrafluoroethylene (TFE): Reinforced with glass fibers and applied to stainless or structural steel plates.

2.02 CONCRETE QUALITIES:

- A. 28-day Compressive Strength: Minimum of 5000 psi.
- B. Release Strength: Minimum of 3500 psi.
- C. Air Content: Conform to PCI MNL-120 Table 1.3.2 for moderate exposure.
- D. Water-Cement Ratio: The water-cement ratio shall not exceed 0.45 for all concrete unless otherwise specified.

2.03 MANUFACTURE:

- A. Manufacturing procedures and tolerances shall comply with PCI MNL-116.
- B. Finishes:
 1. Unformed Surfaces:
 - a. Screed Finish:
 - (1) Use as first stage for all concrete finishes.
 - (2) Use as final finish on surfaces that will be covered by additional concrete.
 - (3) Immediately after screeding, use a wood float, darby, or bullfloat to eliminate high and low spots and to embed large aggregate. This shall be done in a manner to produce even, uniform surfaces so that surface irregularities do not exceed 3/8-inch in 10 feet when used as final finish.
 - b. Floated Finish:
 - (1) Use as second stage of broomed, troweled, or magnesium-troweled finish.
 - (2) Use as final finish on all surfaces unless otherwise indicated or specified.
 - (3) Float with mechanical float. Hand floating will be permitted only in areas inaccessible to mechanical float.
 - (4) On surfaces not to receive troweled or magnesium-troweled finish, finish with wood or cork float after mechanical floating to a true uniform surface so that surface irregularities do not exceed 1/8-inch in 10 feet.
 - c. Broomed Finish:
 - (1) Use as final finish on walkways.
 - (2) After floated finish, draw a stiff bristle broom across the surface making uniform corrugations, perpendicular to the direction of traffic, not more than 1/16 inch deep.
 - d. Troweled Finish:
 - (1) Use as final finish where indicated or specified.
 - (2) Trowel with steel trowel, mechanical or hand, to obtain a smooth, dense finish. The final troweling shall be done after the concrete has become hard enough so that no mortar adheres to the edge of trowel and a ringing sound is produced as the trowel passes over the surface.

SECTION 034120 - PRECAST CONCRETE SECTIONS: continued

- (3) Do not trowel before surface water has evaporated or has been removed with a squeegee.
 - (4) Finish to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet.
 - (5) Do not add sand or cement to the surface.
 - e. Magnesium-Troweled Finish:
 - (1) Perform as specified in Troweled Finish, this Section, except use a magnesium trowel by hand instead of a steel trowel to obtain a dense, but not slick, finish.
 - (2) Use where indicated or specified.
 2. Formed Surfaces:
 - a. Repair surface defects as specified in Repair of Defective Surfaces, this Section.
 - b. Underside of members shall have a smooth finish as derived from steel forms.
 - c. Architectural Grade B Finish:
 - (1) All air pockets and holes over 1/4-inch in diameter shall be filled with a sand-cement paste. All form offsets or fins over 1/8-inch shall be ground smooth.
 3. Repair of Defective Surfaces:
 - a. Defined as any concrete surface showing misalignment, rock pockets, poor joints, holes from ties, voids, honeycomb, spalls, or any other defective area.
 - b. Repairing:
 - (1) Repair as soon as forms have been removed.
 - (2) Prewet depression and brush with neat cement immediately before patching.
 - (3) Patch surfaces using stiff mortar with same sand-cement ratio as original concrete and with minimum water for placing. Blend with white cement to match concrete color.
 - (4) Compact mortar into depressions so that after curing, hole is filled and mortar is flush with surface. Use hammer and ramming rod for compacting the holes.
 - (5) Cure as specified in Curing, this Section.
 - (6) Owner's representative shall be notified of areas containing defects or where reinforcing steel is exposed, prior to determination of repair method.
 - C. Openings:
 1. The manufacturer shall provide for openings 10-inch round or square or larger as shown on the Drawings. Other openings shall be located and field drilled or cut by the trade requiring them after the precast, prestressed products have been erected. Field drilled or cut openings shall be approved in writing by the manufacturer before drilling or cutting.
 - D. Curing:
 1. Cure all concrete by one of the following methods in accordance with PCI MNL-116:
 - a. Accelerated curing.
 - b. Curing with live steam.
 - c. Curing with radiant heat and moisture.
 - d. Curing by moisture retention without heat.
 - e. Membrane curing compound.
 2. When ambient temperatures are expected to be above 100°F or below 40°F, or when required by other weather conditions, conform to Hot Weather Concreting and Cold Weather Concreting methods in accordance with PCI MNL-116.
 - E. Fasteners:

SECTION 034120 - PRECAST CONCRETE SECTIONS: continued

1. Manufacturer shall cast in structural inserts, bolts, and plates as specified, detailed, or required by the Contract Drawings.
- F. Welding of concrete reinforcement shall conform to AWS D1.4.

PART 3 - EXECUTION

3.01 ERECTION:

- A. Site Access: Contractor shall be responsible for providing suitable access to the building, proper drainage, and firm, level bearing for the hauling and erection equipment to operate under their own power.
- B. Preparation:
 1. Contractor shall be responsible for providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.
 2. Contractor shall be responsible for placement and accurate alignment of anchor bolts, plates, or dowels in field placed supporting members.
- C. Installation: Installation of precast, prestressed concrete shall be performed by the manufacturer or a qualified erector. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.
- D. Alignment: Members shall be properly aligned and leveled as required by the approved Shop Drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Owner's Representative.
- E. Grout Keys: Grout all keyways between precast concrete sections full after installation.

3.02 FIELD WELDING:

- A. Field welding shall be done by qualified welders using equipment and materials compatible to the base material.

3.03 ATTACHMENTS:

- A. Anchor to members as indicated. No hand- or explosive-driven inserts, pins, anchors, or drive-ins of any kind shall be used.
- B. All field-cut or drilled openings shall be approved by the manufacturer as to size and location prior to cutting and drilling.
- C. Repair damaged surfaces.

3.04 INSPECTION AND ACCEPTANCE:

- A. Final inspection and acceptance of erected precast, prestressed concrete will be made by Owner's Representative.

END OF SECTION 034120

DIVISION 04 - MASONRY

SECTION 042000 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units.
 - 2. Face brick.
 - 3. Mortar and grout.
 - 4. Reinforcing steel.
 - 5. Masonry joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.
 - 9. Cavity-wall insulation.
- B. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels for unit masonry, furnished under SECTION 051200 - STRUCTURAL STEEL FRAMING.
 - 2. Manufactured reglets in masonry joints for metal flashing, furnished under SECTION 076200 - SHEET METAL FLASHING AND TRIM.
 - 3. Fiberglass doors and frames in unit masonry openings, furnished under SECTION 081613 - FIBERGLASS DOORS AND FRAMES.

1.02 REFERENCES:

- A. American Concrete Institute (ACI):
 - 1. 315 - Details and Detailing of Concrete Reinforcement.
 - 2. 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures.
- B. American Society for Testing and Materials (ASTM):
 - 1. A36/A36M - Carbon Structural Steel.
 - 2. A82 - Steel Wire, Plain, for Concrete Reinforcement.
 - 3. A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. A307 - Carbon Steel Bolts and Studs, 6,000 psi Tensile Strength.
 - 5. A325/A325M - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 6. A366/A366M - Steel Sheet, Carbon, Cold-Rolled, Commercial Quality.
 - 7. A563/A563M - Carbon and Alloy Steel Nuts.
 - 8. A615/A615M - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 9. A616/A616M - Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 10. A617/A617M - Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 11. A653/A653M - Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 12. A767/A767M - Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 13. A951 - Masonry Joint Reinforcement.
 - 14. C67 - Test Methods For Sampling and Testing Brick and Structural Clay Tile.
 - 15. C90 - Loadbearing Concrete Masonry Units.
 - 16. C129 - Nonload-Bearing Concrete Masonry Units.
 - 17. C140 - Test Methods of Sampling and Testing Concrete Masonry Units.
 - 18. C143 - Test Method for Slump of Hydraulic Cement Concrete.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

19. C144 - Aggregate for Masonry Mortar.
 20. C150 - Portland Cement.
 21. C207 - Hydrated Lime for Masonry Purposes.
 22. C216 - Facing Brick (Solid Masonry Units Made from Clay or Shale).
 23. C270 - Mortar for Unit Masonry.
 24. C404 - Aggregates for Masonry Grout.
 25. C476 - Grout for Masonry.
 26. C494 - Chemical Admixtures in Concrete.
 27. C578 - Rigid, Cellular Polystyrene Thermal Insulation.
 28. C780 - Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 29. C1019 - Test Method of Sampling and Testing Grout.
 30. C1093 - Practice for Accreditation of Testing Agencies for Unit Masonry.
 31. C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 32. C1329 - Mortar Cement.
 33. D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 34. D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
 - C. Brick Institute of America (BIA):
 1. M1 - Specifications for Portland Cement-Lime Mortar for Brick Masonry.
 2. Technical Notes No. 20 - Cleaning Brick Masonry.
 3. Technical Notes No. 28B - Brick Veneer, Steel Stud Panel Walls.
 - D. Code of Federal Regulations (CFR):
 1. 29 CFR 1926 - Standards for the Construction Industry (OSHA).
 - E. International Building Code (IBC - 2006).
 - F. National Concrete Masonry Association (NCMA):
 1. TEK 8-2 - Removal of Stains from Concrete Masonry Walls.
- 1.03 DEFINITIONS:
- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
- 1.04 PERFORMANCE REQUIREMENTS:
- A. Provide unit masonry that develops the following net-area compressive strengths (f 'm) at 28 days. Determine compressive strength of masonry from net-area compressive strengths of masonry units and mortar types according to Tables 2105.2.2.1.1 and 2105.2.2.1.2 in IBC.
 1. For Concrete Unit Masonry: f 'm = 2000 psi (13.8 MPa).
 2. For Brick Unit Masonry: f 'm = 3000 psi (17.2 MPa).
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Product Data: For each different masonry unit, accessory, and other manufactured product specified.
 - C. Shop Drawings: Show fabrication and installation details for the following:
 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
 - D. Samples for Initial Selection: For the following:
 1. Unit masonry Samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
 2. Colored mortar Samples showing the full range of colors available.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

- E. Samples for Verification: For the following:
 - 1. Full-size face brick units for each brick selected showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
 - 2. Weep holes.
 - 3. Accessories embedded in the masonry.
 - 4. Colored mortar Samples for each color required, showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
 - F. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents, unless such deviations are specifically brought to the attention of the Engineer and approved in writing.
 - G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
 - H. Material Test Reports: From a qualified testing agency employed and paid by Contractor or manufacturer indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Each type of masonry unit required.
 - a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
 - b. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.
 - 2. Mortar complying with property requirements of ASTM C270.
 - 3. Grout mixes complying with compressive strength requirements of ASTM C476. Include description of type and proportions of grout ingredients.
 - I. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Each type of masonry unit required.
 - a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
 - b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
 - 2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 - 3. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 2105.2.2.1.1 and 2105.2.2.1.2 in IBC.
 - 4. Each material and grade indicated for reinforcing bars.
 - 5. Each type and size of joint reinforcement.
 - 6. Each type and size of anchor, tie, and metal accessory.
 - J. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
- 1.06 QUALITY ASSURANCE:
- A. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Engineer/Architect's satisfaction, based on evaluation of agency-submitted

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

- criteria conforming to ASTM C1093, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- 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, through one source from a 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 one manufacturer for each cementitious component and from one source or producer for each aggregate.
 - D. Preconstruction Testing: Employ and pay a qualified independent testing agency to perform the following preconstruction testing to establish compliance of proposed materials and construction with specified requirements:
 - 1. Concrete Masonry Unit Test: For each different concrete masonry unit indicated, test unit for strength, absorption, and moisture content per ASTM C140.
 - 2. Test mortar properties per test methods of ASTM C780.
 - 3. Evaluate mortar composition and properties per ASTM C780.
 - 4. Test grout compressive strength per ASTM C1019.
 - E. Single-Source Responsibility 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 one source and by a single manufacturer for each different product required.
 - F. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of a uniform quality from one manufacturer for each cementitious component and from one source or producer for each aggregate.
 - G. Mockup: Prior to installing unit masonry, construct sample wall panel in a quality manner to verify selections made under sample submittals and to demonstrate aesthetic effects of materials and execution. Build mockup to comply with the following requirements, using materials indicated for final unit of Work.
 - 1. Locate mockups on site as directed by Engineer/Architect.
 - 2. Build 4'-0" H. x 4'-0" W. mockup to show all aspects of the wall including:
 - a. Concrete Masonry Units (CMU).
 - b. Face brick (field color).
 - c. Face brick (soldier course color).
 - d. Colored mortar (field color).
 - e. Colored mortar (soldier course color).
 - f. Colored sealant (field color).
 - g. Colored sealant (soldier course color).
 - h. Weep holes.
 - i. Horizontal reinforcing.
 - j. Thru-wall flashing.
 - k. Mortar Net.
 - l. Insulation.
 - 3. Clean exposed faces of mockups with masonry cleaner indicated.
 - 4. Notify Engineer/Architect one week in advance of the dates and times when mockups will be constructed.
 - 5. Protect accepted mockup from the elements with weather-resistant membrane.
 - 6. Retain and maintain mockup during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Acceptance of mockup is for color, texture, and blending of masonry units; relationship of mortar and brick colors; tooling of joints; aesthetic qualities of

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

workmanship; and other material and construction qualities specifically approved by Engineer/Architect in writing.

- b. Acceptance of mockup does not constitute approval of deviations from the Contract Documents contained in mockup, unless such deviations are specifically approved by Engineer/Architect in writing.
- c. When directed, demolish and remove mockup from Project site.

1.07 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.
 - 1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.
- 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 designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.08 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 (600 mm) down both sides and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 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 coverings spread 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

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

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°F (4°C) and above and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
1. When ambient temperature exceeds 100°F (38°C), or 90°F (32°C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS:

- A. General: Provide shapes indicated and as follows:
1. Provide special shapes for corners, jambs, sash, control joints, headers, bonding, and other special conditions.
 2. Provide square-edged units for outside corners.
- B. Concrete Masonry Units: ASTM C90 and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
 2. Weight Classification: Normal weight.
 3. Provide Type I, moisture-controlled units.
 4. Size (Width): Manufactured to the following dimensions:
 - a. 4 inches (102 mm) nominal; 3-5/8 inches (97 mm) actual.
 - b. 8 inches (203 mm) nominal; 7-5/8 inches (194 mm) actual.
 5. Exposed Faces: Manufacturer's standard color and texture.

2.02 BRICK:

- A. General: Provide shapes indicated and as follows for each form of brick required.
1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.
- B. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners and movement joints.
 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- C. Face Brick: ASTM C216 and as follows:
1. Grade and Unit Compressive Strength: Provide units with grade and minimum average net-area compressive strength indicated below:
 - a. Grade: SW.
 - b. Compressive Strength:
 - (1) 3000 psi (20.7 MPa) (Minimum).
 2. Initial Rate of Absorption: Between 5 and 20 g/30 sq. in. (g/194 sq. cm) per minute when tested per ASTM C67.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

3. Type: FBS.
4. Size: Bricks manufactured to the following actual dimensions within tolerances specified in ASTM C216:
 - a. Modular: 3-1/2 to 3-5/8 inches (89 to 92 mm) thick by 2-1/4 inches (57 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
 - b. Closure or Economy (Actual Dimensions): 3-1/2 to 3-5/8 inches (89 to 92 mm) wide by 3-1/2 to 3-5/8 inches (89 to 92 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
5. Color and Texture:
 - a. Two colors shall be used for field brick as indicated on the Drawings. One for each building location. Accent brick at Lee Creek WTP may be the same or similar to the field brick as chosen by Engineer to match the brick at each WTP Plant.
 - b. Face brick line of equal value to Sioux City Brick and to be chosen by Engineer to match the brick at each WTP Plant.
6. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."

2.03 MORTAR AND GROUT MATERIALS:

- A. Portland Cement: ASTM C150, 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.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of Portland cement complying with ASTM C150, Type I, or Type III, and hydrated lime complying with ASTM C207.
- D. Mortar Cement: ASTM C1329.
- E. Masonry Cement: ASTM C91.
 1. For pigmented mortar, use a colored cement formulation as required to produce the color indicated or, if not indicated, as selected from manufacturer's standard formulations.
 - a. Pigments shall not exceed 10% of Portland cement by weight for mineral oxides or 2% for carbon black.
 - b. Two colors shall be selected. One for the building field color and one for the building band (soldier course) color.
- F. Aggregate for Mortar: ASTM C144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100% passing the No. 16 (1.18-mm) sieve.
- G. Aggregate for Grout: ASTM C404.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.
- I. Water: Potable.
- J. Products: Subject to compliance with requirements, provide one of the following:
 1. Mortar Cement:
 - a. Blue Circle Cement: Magnolia Superbond Mortar Cement.
 - b. Lafarge Corporation: Lafarge Mortar Cement.
 2. Cold-Weather Admixture:
 - a. Euclid Chemical Co.: Accelguard 80.
 - b. W. R. Grace & Co., Construction Products Division: Morseled.
 - c. Sonneborn, Div. of ChemRex, Inc.: Trimix-NCA.
- K. Preblended mortar and grout mixes that meet the criteria above are acceptable.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

2.04 REINFORCING STEEL:

- A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M; ASTM A616/A616M, including Supplement 1; or ASTM A617/A617M, Grade 60 (Grade 400).
- B. Deformed Reinforcing Wire: ASTM A496, with ASTM A153 Class B2 zinc coating.
- C. Welded-Wire Fabric: ASTM A185.

2.05 MASONRY JOINT REINFORCEMENT:

- A. General: ASTM A951 and as follows:
 - 1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.
 - 2. Wire Size for Side Rods: 9-gauge.
 - 3. Wire Size for Cross Rods: 9-gauge.
 - 4. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units where indicated.
- B. For single-wythe masonry, provide ladder type with single pair of side rods and cross rods spaced not more than 16 inches (407 mm) o.c.
- C. For multi-wythe masonry, provide type as follows:
 - 1. Ladder-eye design with perpendicular cross rods and adjustable wall tie spaced not more than 16 inches (407 mm) o.c.

2.06 TIES AND ANCHORS, GENERAL:

- A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.
- B. Wire Ties: 26-gauge stainless-steel corrugated wall ties.
- C. Galvanized Steel Sheet: ASTM A653/A653M, G60 (Z180), commercial-quality, steel sheet zinc coated by hot-dip process on continuous lines before fabrication.
- D. Steel Sheet, Galvanized after Fabrication: ASTM A366/A366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A153.
- E. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

2.07 MISCELLANEOUS TIES:

- A. Metal Lath Wall Ties:
 - 1. 3.4-lb. galvanized diamond-mesh lath width shall be 1 inch less than wall thickness by length as required by specific requirement but not less than 16 inches.
 - 2. Use in following locations:
 - a. Under masonry cores to be filled with grout.

2.08 MISCELLANEOUS ANCHORS:

- A. Anchor Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568, Property Class 4.6); with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A153, Class C; of diameter and length indicated and in the following configurations:
 - 1. Headed bolts.
 - 2. Nonheaded bolts, straight or bent in manner indicated.

2.09 EMBEDDED FLASHING MATERIALS:

- A. Copper-Laminated Flashing: Laminated flashing consisting of 5-oz./sq. ft. (1.5-kg/sq. m) sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Copper-Laminated Flashing:
 - a. Advanced Building Products, Inc.: Copper Fabric Flashing.
 - b. AFCO Products, Inc.: Copper Fabric.
 - c. Hohmann & Barnard, Inc.: H & B C-Fab Flashing.
 - d. Phoenix Building Products: Type FCC-Fabric Covered Copper.
 - e. Polyrite Manufacturing Corp.: Copper Fabric Flashing.
 - f. Sandell Manufacturing Co., Inc.: Copper Fabric Flashing.
 - g. York Manufacturing, Inc.: York Copper Fabric Flashing.

2.10 MISCELLANEOUS MASONRY ACCESSORIES:

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35%; of width and thickness indicated; formulated from neoprene or PVC.
- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).
- C. Weep Holes: Round plastic tubing, medium-density polyethylene, 3/8-inch OD by 4 inches long.
- D. Mortar Net: High density polyethylene (HDPE) or nylon strands woven into a 90% open mesh 10 inches high by thickness required. Provide the following:
 - 1. Mortar Net USA, Ltd.
- E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch (3.6-mm) steel wire, hot-dip galvanized after fabrication.
 - 1. Provide units with either two loops or four loops as needed for number of bars indicated.
- F. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Reinforcing Bar Positioners:
 - a. Dur-O-Wal, Inc.: D/A 811.
 - b. Dur-O-Wal, Inc.: D/A 816.
 - c. Heckman Building Products, Inc.: No. 376 Rebar Positioner.
 - d. Hohmann & Barnard, Inc.: #RB Rebar Positioner.
 - e. Hohmann & Barnard, Inc.: #RB-Twin Rebar Positioner.

2.11 CAVITY-WALL INSULATION:

- A. Extruded-Polystyrene Board Insulation: Rigid, cellular, polystyrene thermal insulation with closed cells and integral high-density skin; formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C578, Type IV.
 - 1. Thickness: 1-1/2-inch.
 - 2. R-value: 7.5 (min).
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.12 MASONRY CLEANERS:

- A. Use ProSoCo, Inc. or approved equal masonry cleaners as recommended by manufacturer.

2.13 MORTAR AND GROUT MIXES:

- A. General: Do not use admixtures, 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. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

- B. Mortar for Unit Masonry:
 - 1. Comply with ASTM C270, Proportion Specification, for types of mortar indicated below.
 - a. Limit cementitious materials in mortar to Portland cement and lime. Masonry cement will not be acceptable
 - b. For masonry below grade, in contact with earth:
 - (1) Type: S.
 - c. For exterior, above-grade, load-bearing and interior nonload-bearing walls:
 - (1) Type: N.
- C. Grout for Unit Masonry: Comply with ASTM C476. Use grout of consistency at time of placement that will completely fill spaces intended to receive grout.
 - 1. Use fine grout in grout spaces less than 2 inches (50 mm) in horizontal dimension, unless otherwise indicated.
 - 2. Use coarse grout in grout spaces 2 inches (50 mm) or more in least horizontal dimension, unless otherwise indicated.

2.14 MASONRY-CELL INSULATION:

- A. Loose-Granular Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or IV (surface treated for water repellency and to limit dust generation) or vermiculite complying with ASTM C516, Type II (surface treated for water repellency and limited moisture absorption), Grade 3 (Fine), complying with 29 CFR 1926 by containing less than 0.10% by weight of asbestos and that demonstration shows will not release asbestos fibers in excess of 0.1 fibers/cu. cm under reasonably foreseeable Project-Site conditions.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Verify that foundations are within tolerances specified.
 - 2. Verify that reinforcing dowels are properly placed.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.02 INSTALLATION, GENERAL:

- A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.
- D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C67. Allow units to absorb water so they are damp but not wet at the time of laying.

3.03 CONSTRUCTION TOLERANCES:

- A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
- B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.
- C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
- D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.
- E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
- F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

3.04 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. Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
 - 1. One-half running bond with vertical joint in each course centered on units in courses above and below.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
- F. Fill space between hollow-metal 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 in the joint below and rod grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- I. Build non-load-bearing interior partitions as indicated.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

3.05 MORTAR BEDDING AND JOINTING:

- A. Lay hollow masonry units as follows:
 - 1. Lay vertical-cell units with full head joints. Provide bed joints with full mortar coverage on face shells and webs.
 - 2. Lay horizontal-cell units with full bed joints. Keep drainage channels free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit in place and one side of unit to be placed.
 - 3. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch (6- to 10-mm) joints.
 - 4. Bed webs in mortar in starting course on footings and where adjacent to cells or cavities to be filled with grout.
 - 5. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
 - 6. Use appropriate color mortar for field brick and soldier course brick.
- B. Tool exposed joints when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.
 - 1. Slightly concave at all CMU and brick joints.

3.06 BONDING OF MULTI-WYTHE MASONRY:

- A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties as shown. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
- B. Use masonry joint reinforcement installed in horizontal mortar joints to bond wythes together.
- C. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.
 - 1. Provide continuity with masonry joint reinforcement at corners by using prefabricated "L" units as well as masonry bonding.
- D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 - 1. Provide continuity with masonry joint reinforcement by using prefabricated "T" units.
 - 2. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.07 CAVITIES:

- A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.
 - 1. Place temporary wood strips in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.
- B. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

3.08 MASONRY JOINT REINFORCEMENT:

- A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, and other special conditions.

3.09 CONCRETE MASONRY UNIT ANCHOR STRAPS:

- A. General: Install screw-on anchor straps at vertical joints between CMU columns and CMU or brick walls w/adhesive concrete anchors.
 - 1. Install vertically at 16 inches o.c.
 - 2. Install horizontally at 24 inches o.c.

3.10 CONTROL AND EXPANSION JOINTS:

- A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Install preformed control-joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick made from clay or shale as follows:
 - 1. Form open joint of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in SECTION 07920 - JOINT SEALANTS. Keep joint free and clear of mortar.

3.11 LINTELS:

- A. Install steel angles where indicated.
- B. Provide minimum bearing of 16 inches (200 mm) at each jamb, unless otherwise indicated.

3.12 TIES AND ANCHORS:

- A. General: Install ties and anchors in poured concrete walls with face brick.
 - 1. Anchor into shotcrete with stainless steel Tapcon anchor (maximum embedment 1 inch).
 - 2. Install vertically at 16 inches (600 mm) o.c.
 - 3. Install horizontally at 24 inches (900 mm) o.c.

3.13 FLASHING AND WEEP HOLES:

- A. General: Install embedded flashing and weep vents in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, 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.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

- C. Install flashing as follows:
 - 1. At multi-wythe masonry walls, including cavity walls, extend flashing from exterior face of outer wythe of masonry, through outer wythe, turned up a minimum of 8 inches (200 mm), and install as indicated.
 - 2. At lintels and shelf angles, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends.
 - 3. Cut flashing off flush with face of wall after masonry wall construction is completed.
- D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:
 - 1. Use plastic weep tubes to form weeps.
 - 2. Space weeps at 1'-4" on center.
 - 3. Place cavity drainage material (Mortar Net) in cavities as indicated.

3.14 REINFORCED UNIT MASONRY INSTALLATION:

- A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
 - 1. Construct formwork to conform to shape, line, and dimensions shown. Make it 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 temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
 - 1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.15 FIELD QUALITY CONTROL:

- A. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.
- B. Mortar properties will be tested per ASTM C780.
- C. Grout will be sampled and tested for compressive strength per ASTM C1019.
- D. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C67.
- E. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C140.

3.16 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.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

SECTION 042000 - UNIT MASONRY ASSEMBLIES: continued

- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry and mortar joints by methods and products as recommended by brick manufacturer.
 - 1. Remove large mortar particles 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 Design Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering surfaces with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
 - 5. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.
 - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.
 - 8. Clean limestone units to comply with recommendations in the Indiana Limestone Institute of America's "Indiana Limestone Handbook."
- E. Protection: Provide final protection and maintain conditions that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.17 MASONRY WASTE DISPOSAL:

- A. Recycling: Unless otherwise indicated, extra unused bricks to be stacked on a pallet and provided to Owner. At completion of unit masonry work, remove from Project Site.
- B. 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 042000

SECTION 044000 - CAST STONE

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes cast-stone coping, decorative bands, and medallions.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 042000 - UNIT MASONRY ASSEMBLIES.

1.02 REFERENCES:

- A. American Concrete Institute, Structural Engineering Institute of the American Society of Civil Engineers, and The Masonry Society:
 - 1. ACI 530.1/ASCE 6/TMS 602-2005 - Specification for Masonry Structures.
- B. ASTM International:
 - 1. C1364 - Specification for Architectural Cast Stone.

1.03 SUBMITTALS:

- A. Compliance Submittals:
 - 1. Submit as specified in DIVISION 01.
 - 2. Include, but not limited to, the following:
 - a. Manufacturer's data, specifications.
 - b. Complete setting drawings including the sizes, section and dimensions of stone, the arrangement of joints and bonding, typical and special anchoring, doweling, other necessary details, and setting number of each stone. Each stone shall bear the corresponding number marked on the back or unexposed edge with a nonstaining paint.
 - 3. Samples for initial selection of the following:
 - a. Stone samples in size approximately 4 inches by 6 inches by 1 inch, showing the full range of colors and textures available.

1.04 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: Only cast stone of established manufacturers whose products have been used with satisfactory results will be considered. Manufacturer shall furnish such references.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Carefully pack cast stone for shipment, with precautions against damage in transit.
- B. Store all stone on planks or timber so that stone is clear of ground. For planks or timber in contact with stone, use cypress, white pine, poplar, or yellow pine without an excessive amount of resin. Do not use any woods containing tannin.
- C. Cover at all times with tarpaulins, or stout nonstaining paper. Protect from any damage which would result from any accumulation of dirt, dust, soot, mud, grease, or other staining or disfiguring elements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products from the following:
 - 1. Heritage Cast Stone.
 - 2. Approved equal.

SECTION 044000 - CAST STONE: continued

2.02 CAST STONE:

- A. Meet or exceed the requirements of ASTM C1364 - Specification for Architectural Cast Stone.
- B. Cast stone shall have a minimum compressive strength of 6,500 psi.
- C. Maximum moisture absorption shall not be more than 6% or less than 3%.
- D. Efflorescence: Provide cast stone that has been tested according to ASTM C67 and is rated "not effloresced."
- E. Entire quantity of stone shall be cast from a single source of cement and sand.
- F. Cast all stone accurately to shape and dimensions indicated. All beds and vertical joints shall have a uniform thickness of 1/4 inch.
- G. Patching or hiding of defects will not be permitted.
- H. Cast or drill all holes for all anchors, dowels, etc., specified or indicated.
- I. Incidental field cutting, drilling and dressing shall be done by skilled workmen before stones are set.
- J. Cast Stone Reinforcing: Provide reinforcing for all pieces over 3 ft.-6 inches in length and as follows:
 - 1. Over 4 inches in depth - two No. 3 reinforcing bars.
 - 2. Provide a minimum of 2 inches of concrete between reinforcing bar and any surface of the stone exposed to the weather.

2.03 MORTAR: Stone setting and pointing mortar shall be same as used for block as specified in SECTION 042000.

2.04 ANCHORS:

- A. Anchors, dowels, or clamps shall be stainless steel.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. When necessary, before setting stone, thoroughly clean all exposed surfaces by washing with fiber brush and soap powder, then rinse thoroughly with clear water.
- B. Immediately prior to setting of stone, sponge stone with clean water.

3.02 INSTALLATION:

- A. General Requirements:
 - 1. Set stone accurately, plumb, square, level and true with uniform joints.
 - 2. Set all stone in full beds of mortar with all vertical joints flushed full. All beds and vertical joints shall be a maximum width of 1/4 inch.
 - 3. Remove all shims below cast stone panels and bands before mortar has set completely.
 - 4. Completely fill all anchor, dowel and similar holes.
 - 5. Rake joints 3/4 inch from face of stone to allow for backer rod and sealant. Refer to SECTION 079200 for application of sealant and backer rod.
 - 6. Avoid splashing of mortar on exposed face of stone. Remove mortar droppings immediately with sponge and clean water.
 - 7. After mortar has set, brush joints out clean, thoroughly wet joints, and point flush with pointing mortar.
 - 8. Apply clear sealer as recommended by manufacturer.

SECTION 044000 - CAST STONE: continued

3.03 CLEANING:

- A. Clean stone with products and by methods as recommended by stone manufacturer.
- B. The use of sandblasting, wire brushes, acids or abrasives will not be permitted.

END OF SECTION 044000

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Adhered membrane roofing system.
 - 2. Vapor retarder.
 - 3. Roof insulation.
- B. Related Sections include the following:
 - 1. SECTION 076200 - SHEET METAL FLASHING AND TRIM for metal roof penetration flashings, flashings, and counterflashings.
 - 2. SECTION 079200 - JOINT SEALANTS for sealants.

1.02 REFERENCES:

- A. American Society for Testing and Materials (ASTM):
 - 1. C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 2. D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - 3. D312 - Asphalt Used in Roofing.
 - 4. D412 - Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
 - 5. D448 - Classification for Sizes of Aggregate for Road and Bridge Construction.
 - 6. D471 - Test Method for Rubber Property - Effect of Liquids.
 - 7. D573 - Test method for Rubber - Deterioration in an air Oven.
 - 8. D624 - Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 9. D746 - Test method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - 10. D751 - Test Methods for Coated Fabrics.
 - 11. D1079 - Terminology Relating to Roofing, Waterproofing, and Bituminous Materials.
 - 12. D1149 - Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber.
 - 13. D1204 - Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - 14. D2178 - Asphalt Glass Felt Used in Roofing and Waterproofing.
 - 15. D4263 - Test Method of Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 16. D4397 - Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 - 17. D6152 - SEBS - Modified Mopping Asphalt Used in Roofing.
 - 18. D6878 - Thermoplastic Polyolefin Based Sheet Roofing.
 - 19. E108 - Test Methods for Fire Tests of Roof Coverings.
 - 20. E119 - Test Method for Fire Tests of Building Construction and Materials.
 - 21. E548 - Guide for General Criteria Used for Evaluating Laboratory Competence.
 - 22. E1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- B. American Society of Civil Engineers (ASCE):
 - 1. 7 - Minimum Design Loads for Buildings and Other Structures.
- C. Factory Mutual Global (FMG):
 - 1. 4450 - Approval Standard for Class 1 Insulated Steel Deck Roofs (with 1992 Supplement).
 - 2. 4470 - Approval Standard Class 1 Roof Covers (with 1987 and 1992 Supplements).
 - 3. Approval Guide.

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING: continued

- D. Single-Ply Roofing Institute (SPRI):
 - 1. ANSI/SPRI RP-4 - Wind Design Standard for Ballasted Single-Ply Roofing Systems.
 - 2. Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems.
- E. U.S. Department of Commerce, National Institute of Standards and Technology (DOC):
 - 1. PS 2 - Performance Standard for Wood-Based Structural-Use Panels.

1.03 DEFINITIONS:

- A. Roofing Terminology: Refer to ASTM D1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.
- C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

1.04 PERFORMANCE REQUIREMENTS:

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail Resistance: SH.
- D. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

1.05 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Insulation fastening patterns.
- D. Samples for Verification: For the following products:
 - 1. 12- by 12-inch (300- by 300-mm) square of sheet roofing, of color specified, including T-shaped side and end lap seam.
- E. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system. Installer has held manufacturer's installation certificate for a minimum of five years.

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING: continued

- F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- G. Qualification Data: For Installer and manufacturer.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- I. Research/Evaluation Reports: For components of membrane roofing system.
- J. Maintenance Data: For roofing system to include in maintenance manuals.
- K. Warranties: Special warranties specified in this Section.
- L. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.06 QUALITY ASSURANCE:

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Manufacturer Qualifications: A qualified manufacturer that has FMG approval for membrane roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E548.
- D. Source Limitations: Obtain components for membrane roofing system approved by roofing membrane manufacturer.
- E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E108, for application and roof slopes indicated.
 - 2. Fire-Resistance Ratings: ASTM E119, for fire-resistance-rated roof assemblies of which roofing system is a part.
- F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project Site. Comply with requirements for preinstallation conferences in DIVISION 01. Review methods and procedures related to roof deck construction and roofing system:

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver roofing materials to Project Site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING: continued

1.08 PROJECT CONDITIONS:

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.09 WARRANTY:

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
 - 1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, vapor retarder, walkway products, and other components of membrane roofing system.
 - 2. Warranty Period: 20 years from date of Achievement of Full Operations.
- B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Achievement of Full Operations.

PART 2 - PRODUCTS

2.01 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE:

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D6878, uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced, and as follows:
 - 1. Manufacturers:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products Company.
 - c. GAF Materials Corporation.
 - d. GenFlex Roofing Systems.
 - e. Johns Manville International, Inc.
 - f. Sarnafil Inc.
 - g. Stevens Roofing Systems; div. of JPS Elastomerics.
 - h. Versico Inc.
 - 2. Thickness: 60 mils (1.5 mm), nominal.
 - 3. Exposed Face Color: White.
 - 4. Physical Properties:
 - a. Breaking Strength: 225 lbf (1 kN); ASTM D751, grab method.
 - b. Elongation at Break: 15%; ASTM D751.
 - c. Tearing Strength: 55 lbf (245 N) minimum; ASTM D751, Procedure B.
 - d. Brittleness Point: -22°F (30°C).
 - e. Ozone Resistance: No cracks after sample, wrapped around a 3-inch (75-mm) diameter mandrel, is exposed for 166 hours to a temperature of 104°F (40°C) and an ozone level of 100 pphm (100 mPa); ASTM D1149.
 - f. Resistance to Heat Aging: 90% minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240°F (116°C); ASTM D573.
 - g. Water Absorption: Less than 4% mass change after 166 hours' immersion at 158°F (70°C); ASTM D471.
 - h. Linear Dimension Change: ±2%; ASTM D1204.

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING: continued

2.02 AUXILIARY MATERIALS:

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard water-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.
- D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.
- E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.03 VAPOR RETARDER:

- A. Glass-Fiber Felts: ASTM D2178, Type IV, asphalt-impregnated, glass-fiber felt.

2.04 ROOF INSULATION:

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers:
 - a. AlliedSignal Inc.; Commercial Roofing Systems.
 - b. Apache Products Company.
 - c. Atlas Roofing Corporation.
 - d. Carlisle SynTec Incorporated.
 - e. Celotex Corporation.
 - f. Firestone Building Products Company.
 - g. GAF Materials Corporation.
 - h. GenFlex Roofing Systems.
 - i. Hunter Panels, LLC.
 - j. Johns Manville International, Inc.
 - k. Koppers Industries.
 - l. RMAX.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.05 INSULATION ACCESSORIES:

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING: continued

- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.
- D. Gypsum-Fiber cover board.

2.06 ASPHALT MATERIALS:

- A. Roofing Asphalt: ASTM D312, Type III or IV.
- B. Asphalt Primer: ASTM D41.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place, set and braced.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations, and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane is flat.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof downspouts and conductors and from spilling or migrating onto surfaces of other construction. Remove drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.03 VAPOR-RETARDER INSTALLATION:

- A. Install 2 glass-fiber felt plies lapping each sheet 19 inches (483 mm) over preceding sheet. Embed each sheet in a solid mopping of hot roofing asphalt. Glaze-coat completed surface with hot roofing asphalt. Apply hot roofing asphalt at a rate of 20 lb./100 sq. ft. (1 kg/sq. m), $\pm 25\%$.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.04 INSULATION INSTALLATION:

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 1-1/2 inches (38 mm) or greater, install 2 or more layers

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING: continued

with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

- E. Trim surface of insulation where necessary so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
 - 2. Set each layer of insulation in a cold fluid-applied adhesive.

3.05 ADHERED ROOFING MEMBRANE INSTALLATION:

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
 - 1. Install sheet according to ASTM D5036.
- B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply water-based bonding adhesive to substrate at rate required by manufacturer and immediately install roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- E. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
- H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

3.06 BASE FLASHING INSTALLATION:

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING: continued

3.07 WALKWAY INSTALLATION:

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.08 FIELD QUALITY CONTROL:

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Engineer or Owner 48 hours in advance of date and time of inspection.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.09 PROTECTING AND CLEANING:

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Engineer and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Achievement of Full Operations and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075400

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes sheet metal flashing and trim in the following categories:
 - 1. Roof-drainage systems.
 - 2. Exposed trim.
- B. Related Work Specified Elsewhere:
 - 1. DIVISION 04 for through-wall flashing and other integral masonry flashings specified as part of masonry work.
 - 2. DIVISION 07 for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work.
 - 3. SECTION 079200 for Elastomeric sealants.

1.02 REFERENCES:

- A. Aluminum Association (AA):
 - 1. Designation System for Aluminum Finishes, 7th Ed.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. 606.2 - Integral Color Anodic Finishes for Architectural Aluminum.
- C. American Society for Testing and Materials (ASTM):
 - 1. A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. A755/A755M - Steel Sheet, Metallic-Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - 3. B32 - Solder Metal.
 - 4. B209/209M - Aluminum and Aluminum-Alloy Sheet and Plate.
 - 5. B221/B221M - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - 6. D4397 - Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 - 7. D4586 - Asphalt Roof Cement, Asbestos-Free.
- D. Federal Specifications (FS):
 - 1. UU-B-790a - Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent, and Fire Resistant).
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. Architectural Sheet Metal Manual.
- F. Society for Protective Coatings (SSPC):
 - 1. Paint 12 - Cold-Applied Asphaltic Mastic (Extra Thick Film).

1.03 PERFORMANCE REQUIREMENTS:

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

1.04 SUBMITTALS:

- A. Submit in accordance with DIVISION 01.
- B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
- C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

- D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
 - 1. 8-inch (200-mm) square Samples of specified sheet materials to be exposed as finished surfaces.
 - 2. 12-inch (300-mm) long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

1.05 QUALITY ASSURANCE:

- A. Installer Qualifications: Engage an experienced Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.06 PROJECT CONDITIONS:

- A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Provide for leakproof weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.01 METALS:

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:
 - 1. Factory-Painted Aluminum Sheet: ASTM B209 (ASTM B209M), 3003-H14, with a minimum thickness of 0.040 inch (1.0 mm), unless otherwise indicated or specified.
- B. Galvanized Steel Sheet: ASTM A653 (ASTM A653M), hot-dip galvanized steel sheet with 0.20% copper, mill phosphatized where indicated for painting; not less than 0.0396 inch (1.0 mm) thick, unless otherwise indicated or specified.

2.02 SHEET METAL FLASHING AND FABRICATIONS:

- A. Sheet Metal Fabrications:
 - 1. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.
 - 2. Gutters: Fabricate from the following material:
 - a. Aluminum: 0.040 inch (1.0 mm) thick.
 - 3. Downspouts: Fabricate from the following material:
 - a. Aluminum: 0.024 inch (0.6 mm) thick.
 - 4. Conductor Heads: Fabricate from the following material:
 - a. Aluminum: 0.0320 inch (0.8 mm) thick.
 - 5. Scuppers: Fabricate from the following material:
 - a. Aluminum: 0.0320 inch (0.8 mm) thick.
- B. Miscellaneous Materials and Accessories:
 - 1. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

2. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.
 3. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
 4. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in SECTION 079200.
 5. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior and interior nonmoving joints, including riveted joints.
 6. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
 7. Paper Slip Sheet: 5-lb./square (0.244 kg/sq. m) red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.
 8. Polyethylene Underlayment: ASTM D4397, minimum 6-mil (0.15-mm) thick black polyethylene film, resistant to decay when tested according to ASTM E154.
 9. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.
 10. Roofing Cement: ASTM D4586, Type I, asbestos free, asphalt based.
- C. Fabrication, General:
1. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
 2. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Form exposed sheet metal work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
 4. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 5. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 6. Expansion Provisions: Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
 7. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 8. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
 9. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

10. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
 - a. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Install exposed sheet metal work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.
- D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal work. Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- E. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant. Use joint adhesive for nonmoving joints specified not to be soldered.
- F. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
 1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
 2. Bed flanges of work in a thick coat of roofing cement where required for waterproof performance.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

- I. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.
 - J. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Weld or seal flashing to equipment support member.
- 3.03 CLEANING AND PROTECTION:
- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
 - B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim work during construction is without damage or deterioration other than natural weathering at the time of Achievement of Full Operations.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes sealants and related materials for application in the joint locations specified in PART 2, this Section.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. C920 - Elastomeric Joint Sealants.
 - b. C1193 - Guide for Use of Joint Sealants.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Includes, but not limited to, the following for each type of sealant or associated material required:
 - 1. Product data and Specifications, including instructions for joint preparation and sealer application.
 - 2. Color charts.

1.04 QUALITY ASSURANCE:

- A. Manufacturer of sealants shall have a minimum of five years of successful experience in the production of types of sealants required.
- B. Sealant installer shall be certified by the sealant manufacturer as having the necessary experience and equipment to install the materials properly.
- C. Obtain joint sealant materials from a single manufacturer for each different product required.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver all materials in original sealed containers or bundles with labels and inscriptions legible and intact, and informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store all materials in areas suitable to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 PROJECT CONDITIONS:

- A. Environmental Conditions:
 - 1. Do not proceed with installation of joint sealers under the following conditions:
 - a. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40°F (4.4°C).
 - b. When joint substrates are wet due to rain, frost, condensation, or other causes.
- B. Joint Width Conditions: Do not proceed with installation of joint sealers where joint widths are more or less than allowed by joint sealer manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.
- D. Proceed with application only when forecasted weather conditions are favorable for proper cure and development of bond strength.

SECTION 079200 - JOINT SEALANTS: continued

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer listed under each type of material is to establish minimum quality and specific type. Equivalent products of manufacturers listed below will be acceptable subject to suitability for intended condition.
- B. Sealants and Caulking:
 - 1. Bostik Construction Products Div.
 - 2. Dow Corning Corp.
 - 3. General Electric Co.
 - 4. Pecora Corporation.
 - 5. Sika Chemical Corp.
 - 6. Sonneborn Building Products.
 - 7. Tremco Manufacturing Company.
 - 8. W. R. Meadows, Inc.
- C. Sealant Backer Rod (Closed-Cell):
 - 1. Bostik Construction Products Div.
 - 2. Sonneborn Building Products - Sonofoam.
 - 3. W. R. Meadows - Sealtight Backer Rod or Cera-Rod.

2.02 GENERAL:

- A. Before purchase of each specified sealant, investigate its compatibility with the joint surfaces, joint fillers, and other materials in the joint system. Select materials for compatibility with joint surfaces and other indicated exposures, and, except as otherwise indicated, select modulus of elasticity and hardness or grade recommended by manufacturer for each application indicated.
- B. Provide colors as selected by Engineer's Consultant from manufacturer's standard colors.

2.03 ELASTOMERIC SEALANTS:

- A. Sealants conforming to equivalent Federal Specifications will be acceptable.
- B. One-Component Urethane Sealant - Use NT:
 - 1. Conform to ASTM C920, Type S, Grade NS, Class 25. Use classification as required by locations stated below.
 - 2. Manufacturers:
 - a. Pecora Corp. - Dynatrol I.
 - b. Tremco - Dymonic.
 - 3. Use in the following locations:
 - a. Exterior and interior joints around perimeter door and window frames.
 - b. Exterior and interior joints at penetration of walls, decks, and floors by piping, conduit, and other services or equipment except fire-rated penetrations.
 - c. Expansion Joints (EJ).
 - d. Roof flashing materials as indicated.
 - e. Roof flashing reglets and retainers.
 - f. Between precast roof panels.
 - g. Miscellaneous locations as indicated.
 - h. Miscellaneous locations as required (but not indicated).

SECTION 079200 - JOINT SEALANTS: continued

2.04 MISCELLANEOUS MATERIALS:

- A. Joint Cleaner: Type as recommended by the sealant manufacturer for the joint surfaces to be cleaned, which is not harmful to substrates and adjacent surfaces and which does not leave oily residues or have detrimental effect on sealant adhesion or in-service performance.
- B. Joint Primer/Sealer: Type as recommended by the sealant manufacturer for the joint surfaces to be primed or sealed.
- C. Bond-Breaker Tape:
 - 1. Polyethylene tape or other plastic tape as recommended by the sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint, where such adhesion would result in sealant failure.
 - 2. Provide self-adhesive tape where applicable.
- D. Sealant Backer Rod:
 - 1. Compressible rod stock, preformed, resilient, nonwaxing, nonextruding strips of flexible, nongassing plastic foam, nonabsorbent to water and gas, and of size, shape and density, sealant depth, and that otherwise contributes to optimum sealant performance.
 - 2. Rod shall be of size that will compress 25% in joint width and shape to control joint depth, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed.

PART 3 - EXECUTION

3.01 JOINT SURFACE PREPARATION:

- A. Joint Cleaning:
 - 1. Clean joint surfaces immediately before application of sealant.
 - 2. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust, paints (except for permanent protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealers, oil, grease, waterproofing water repellents, water, surface dirt, and frost.
 - 3. Clean concrete, masonry, and similar porous joint surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above operations by vacuuming or blowing out joints with oil-free compressed air.
 - 4. Clean metal and other nonporous surfaces with chemical cleaners or other means which are not harmful to substrates and do not leave residues capable of interfering with adhesion of joint sealers.
 - 5. Remove laitance and form-release agents from concrete.
- B. Joint Priming: Prime joint substrates as required by joint sealant manufacturer. Confine primers to areas of joint sealer bond; do not allow spillage or migration onto adjoining surfaces.
- C. Surface Protection: Use where required to prevent contact of sealant with adjoining surfaces which would otherwise be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

SECTION 079200 - JOINT SEALANTS: continued

3.02 APPLICATION:

- A. Conform to sealant manufacturer's printed instructions except where more stringent requirements apply.
 - 1. For sealant installation, comply with ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install joint-filler units at depth or position in joint to coordinate with other Work, including installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between ends of joint fillers. Do not stretch, twist, puncture, or tear joint fillers. Remove absorbent joint fillers which have become wet prior to sealant installation and replace with dry materials.
- C. Install sealant backer rod for sealants except where indicated to be omitted.
- D. Install bond-breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to back of joints would result in sealant failure.
- E. Install sealants by proven installation techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths, which allow optimum sealant-movement capability.
- F. Install sealants to depths as indicated or, if not indicated as recommended by sealant manufacturer within the following limitations:
 - 1. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
- G. Unless indicated otherwise, provide a slightly concave surface conforming to ASTM C1193. (Provide recessed or flush configuration where indicated.)
- H. Do not allow sealants or compounds to overflow from confines of joint or spill onto adjoining surfaces. Clean the adjoining surfaces to eliminate evidence of spillage without damage to adjoining surfaces or finishes.
- I. Immediately after sealant installation and prior to time skimming or curing begins, tool nonsag sealants to form smooth uniform beads of configuration indicated to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Do not use tooling agent which would discolor sealants or adjacent surfaces or are not approved by sealant manufacturer. Remove excess sealant from surfaces adjacent to joint.

3.03 CURE AND PROTECTION:

- A. Cure sealants in compliance with manufacturer's printed instructions and recommendations to obtain high early bond strength, internal cohesive strength, and surface durability. Cure and protect sealants in a manner which will minimize increases in modulus of elasticity and other accelerated aging effects. Replace or restore sealants which are damaged or deteriorated during construction period. Repaired areas shall be indistinguishable from original Work.

3.04 FIELD QUALITY CONTROL:

- A. After nominal cure of exterior joint sealants which are exposed to weather, test for water leaks as follows:
 - 1. Flood joint exposure with water directed from a 3/4-inch garden hose and connected to water system with 25-psi minimum static water pressure.
 - 2. Hold hose perpendicular to wall face, 2 ft.-0 inches from joint, and move stream of water along joint at approximate rate of 20 feet per minute.
 - 3. Test approximately 5% of total joint system in locations which are typical of every joint condition and which can be inspected easily for leakage on opposite face.

SECTION 079200 - JOINT SEALANTS: continued

4. Perform tests in presence of Engineer's Consultant.
- B. Repair sealant installation at leaks or, if leakage is excessive, replace sealant installation as required. Do not perform repair or replacement work until joints are dry.

END OF SECTION 079200

DIVISION 08 - DOORS AND WINDOWS

SECTION 081613 - FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes heavy-duty, corrosion-resistant, fiberglass-reinforced plastic (FRP) doors and frames.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 087000 - FINISH HARDWARE.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Standards for Testing and Materials (ASTM):
 - a. E84 - Surface Burning Characteristics of Building Materials.
 - 2. American National Standards Institute (ANSI):
 - a. A117.1 - Specifications for ADA requirements and handicap accessibility.
 - b. A250.4-2001 - Swinging doors and frames.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Include product literature, elevations, profiles, construction details, and specifications. Include instructions pertaining to product storage and handling.
 - 2. Shop Drawings: Include elevations of each door and frame type, details, and door schedule using Engineer's door numbers.
 - 3. Samples: Include small Sample (approximately 8" x 10") to show door and frame construction. Also provide color chips for selection of color(s) by Engineer/Architect from manufacturer's standards.
 - 4. Warranty.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Ship all doors and frames as complete units, with trim and all necessary items which may be required for final installation.
- B. Deliver all materials to the site in sealed, undamaged containers, fully identified.
- C. Store materials in original containers, on end, and in a manner to prevent falling or damage to face, corners, or edges.

1.05 QUALITY ASSURANCE:

- A. Doors and frames shall be by the same manufacturer.
- B. Hardware, glass, glazing, and louvers shall be coordinated with door system manufacturer to assure proper reinforcement and fit.
- C. Manufacturer shall be capable of manufacturing door system suitable for intended purpose and of quality as specified herein.

1.06 WARRANTY:

- A. Fiberglass-reinforced plastic doors and frames shall be guaranteed not to fail due to corrosion for a period of 5 years from date of Substantial Completion.

SECTION 081613 - FIBERGLASS DOORS AND FRAMES: continued

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Advance Fiberglass Inc. - Fib-R-Dor, by Chase Industries.
- B. Chem-Pruf Door Co. - Isaac Escorza, isaac@chem-pruf.com
- C. Composite Structures - Tiger Door.
- D. Fenestra Corp.
- E. Fiberglass Technologies Inc.
- F. Simon Door - Esmi, esmi@simondoor.com

2.02 CONSTRUCTION:

- A. Door Construction:
 - 1. Doors shall be of fiberglass-reinforced plastic (FRP) using polymers tailored to the specific corrosive environment. Glass content shall be a minimum of 35% by weight. Doors shall be flush construction with no seams or cracks, 1-3/4-inch thickness. Voids between door plates shall be filled with Polypropylene Honeycomb (PPC) core material (minimum R-value of 2.0). Doors shall have a flame spread of 25 or less per ASTM E84.
 - 2. Plates, styles, and rails shall be constructed of layered FRP and molded in one continuous piece to door dimensions.
 - a. Use vinyl ester resin for plate construction.
 - 3. Doors shall have adequate reinforcing and compression members to accommodate hinges and all other required hardware.
 - 4. Window opening moldings shall be molded integrally with or molded separately and securely fastened to door plates so moisture will not penetrate the door cavity. Provide windows with glazing pins sealed to maintain integrity of system.
 - 5. Color shall be a light color as selected by Engineer from manufacturer's full range of colors and glosses.
 - a. Corrosive environment that includes the storage of: Fluosilicic or Fluorosilicic acid and Hydroflosilicic or Hydrofluorosilicic acid.
 - b. Finish shall be smooth/gloss free of cavities and crevices.
 - c. Manufacturer's 25 mil high performance molded in gel coat finish.
- B. Frame Construction:
 - 1. Frame construction shall be similar to door construction and materials, of stick and header type, mortised and tenoned for the header joint, 2" depth x 5-3/4" or 6" width.
 - 2. Frames shall have adequate reinforcing for hinges and other hardware. Mortises for hinges shall be molded into frame.
 - 3. Provide fiberglass frames for doors, transoms and fixed interior windows.
- C. Doors and frames shall be prefitted and assembled so that no cutting or other modifications shall be required in the field.
- D. Provide doors with all necessary screws, anchors, fasteners, and expansion bolts as required for installation. Metal shall be of corrosion-resistant material. Maintain warranty same as for doors.
- E. Transom Panels: Construct same as adjacent doors and frames.
- F. Hardware: Specified in SECTION 087000.

SECTION 081613 - FIBERGLASS DOORS AND FRAMES: continued

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Frames:

1. Erect frames as walls progress.
2. Erect doors after completion of adjacent walls. Erect door frames plumb, square, true, securely braced, and in accordance with the manufacturer's recommendations.
3. Anchor framing members to jambs. Space anchors not more than 24 inches apart.
4. Make member-to-member connections with appropriate clips and stainless steel screws.
5. After installation of frames, remove temporary braces and spreader bars if used.

B. Doors and Hardware:

1. Carefully and properly hang doors, install hardware, lubricate, and adjust each item of hardware for proper operation.
2. For installation of hardware other than specified this Section, refer to SECTION 087000. Exposed fasteners shall be stainless steel.

3.02 ADJUSTMENTS AND CLEANING:

- A. Remove dirt and excess sealants, lubricants, and glazing compounds from exposed surfaces.
- B. Repair minor surface abrasions and scratches to original new finish. If dents or other damage are unrepairable, replace entire door or frame.
- C. Protect completed installation.

END OF SECTION 081613

SECTION 087000 - FINISH HARDWARE

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes hardware for the proper installation, operation, and control of doors.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 081613 - FIBERGLASS DOORS AND FRAMES.
 - 2. SECTION 281000 - ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American National Standards Institute (ANSI):
 - a. A115 Series - Door and Frame Preparation.
 - b. A156 Series - Hardware.
 - 2. Builders Hardware Manufacturers Association (BHMA):
 - a. 1301 - Materials and Finishes.
 - 3. Door and Hardware Institute (DHI):
 - a. Keying - Procedures, Systems and Nomenclature.
 - b. Architectural Hardware Scheduling Sequence and Schedule Format.
 - c. Abbreviations and Symbols.
 - d. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames.
 - e. Recommended Procedure for Processing Hardware Schedules and Templates.
 - f. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames.
 - 4. Underwriters Laboratories (UL):
 - a. Building Materials Directory.
 - b. 305 - Panic Hardware.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Includes, but not limited to, the following:
 - 1. Product data includes manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 - 2. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - (1) Type, style, function, size, and finish of each hardware item.
 - (2) Name and manufacturer of each item.
 - (3) Fastenings and other pertinent information.
 - (4) Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - (5) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - (6) Mounting locations for hardware.
 - (7) Door and frame sizes and materials.
 - (8) Keying information.

SECTION 087000 - FINISH HARDWARE: continued

- b. Keying Schedule: Submit separate detailed schedule indicating clearly how the Engineer's final instructions on keying of locks has been fulfilled.
- c. Templates for doors, frames, and other Work specified to be factory prepared for the installation of door hardware. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.04 QUALITY ASSURANCE:

- A. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Engineer and Contractor for consultation at reasonable times during the course of the Work.
 - 1. Require supplier to meet with Engineer to finalize keying requirements and to obtain final instructions in writing.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (Project Site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.06 COORDINATION:

- A. Coordinate hardware with other Work.
- B. Furnish templates and other detail matter as required to each fabricator of doors and frames, and to other Work to be prepared for the installation of hardware.
- C. Where Modifications to this Specification are required due to unanticipated conditions, make recommendations of alternative procedures to the Engineer for his consideration and approval.

1.07 MAINTENANCE:

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Engineer's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

- 2.01 ACCEPTABLE PRODUCTS: Items of hardware are specified in Door Schedule, with reference to the listing given in this Part - PRODUCT REQUIREMENTS.

SECTION 087000 - FINISH HARDWARE: continued

2.02 PRODUCT REQUIREMENTS:

- A. Hardware shall meet the respective applicable standards specified in PART 1, this Section.
- B. Provide hardware complete with all fasteners, anchors, instructions, layout templates, and any specialized tools as required for satisfactory installation and adjustment.
- C. Provide manufacturer's standard products meeting the design intent of this Specification, free of imperfections affecting appearance or serviceability.
- D. Hardware is specified in PART 2 - HARDWARE SETS, this Section, by type and function category, each of which has been selected as that best meeting the application. Acceptable products are given for each category as follows:

2.03 HARDWARE SCHEDULE: Refer to the Door Schedule on the Drawings to ascertain hands, and sizes.

SET #1

| | |
|-------|--|
| Doors | 101, 201 |
| 1 ea. | Cont. Hinge 112HD EPT 628 |
| 1 ea. | Power Transfer EPT10 689 |
| 1 ea. | Electric Panic Device RX-QEL+-98-L-NL-06 628 |
| 1 ea. | Cylinder Verify Type Required 626 |
| 1 ea. | Door Contact 679-05HM BLK |
| 1 ea. | Power Supply PS904 900-4RL-FA LGR |
| 1 ea. | Rain Drip Cap R201A AL |
| 1 set | Door Seal 39C AL |
| 1 ea. | Door Sweep 323C AL |
| 1 ea. | Threshold S204A AL |
| 1 ea. | Surface Closer 4040XP SHCUSH SRI 689 |

Refer to Electrical for card reader

SET #2

| | |
|-------|--|
| Doors | 102, 202 |
| 1 ea. | Cont. Hinge 112HD 628 |
| 1 ea. | Cont. Hinge 112HD EPT 628 |
| 1 ea. | Power Transfer EPT10 689 |
| 1 set | Const Latching Bolt FB51P 630 |
| 1 ea. | Electric Panic Device RX-QEL+-98-L-NL-06 628 |
| 1 ea. | Cylinder Verify Type Required 626 |
| 1 ea. | Door Contact 679-05HM BLK |
| 1 ea. | Coordinator COR X FL 628 |
| 2 ea. | Mounting Bracket MB 689 |
| 2 ea. | Surface Closer 4040XP SHCUSH SRI 689 |
| 1 ea. | Rain Drip Cap R201A AL |
| 1 set | Door Seal 39C AL |
| 1 ea. | Threshold S204A AL |
| 2 ea. | Door Sweep 323C AL |
| 1 ea. | Astragal 276C AL |

Refer to Electrical for card reader

SECTION 087000 - FINISH HARDWARE: continued

Operation: Door normally closed and locked. Entry via valid card read. Always free for egress.

| <u>PRODUCT</u> | <u>MANUFACTURER</u> |
|--|---------------------------|
| Contact, Power Supply | Schlage Electronics (SCE) |
| Surface Closers | L.C.N. |
| Flush Bolt, Coordinator, | Ives |
| Continuous Hinge, Latching Bolts, Mounting Bracket | |
| Threshold, Seal, Drip Cap, Sweep, Astragal | Reese |
| Exit Devices, Power Transfer | Von Duprin |

2.04 KEYING:

- A. Keying requirements shall be determined by consultation with the Owner.
- B. Tag and identify keys.
- C. Provide three keys for each lock or cylinder.
- D. Master key in groups as directed.
- E. Key to existing master key system.
- F. Provide construction master keys for all exterior doors.

2.05 MATERIALS AND FABRICATION:

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location.
 - 1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Base Metals: Produce hardware units of manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods except as otherwise specified.
- C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated or specified.
- D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed screws to match hardware finish.
- E. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use hex screw fasteners.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Check all frames and doors for proper hardware cutouts and reinforcements.
- B. Except as specified otherwise, install articles of hardware after finishes have been completed on the substrate. Note all requirements for coordination with protective coating applications.

SECTION 087000 - FINISH HARDWARE: continued

- C. Install hardware at such a time in the Project schedule so as to minimize the possibility of damage from the activity of other trades prior to acceptance.
- D. Check the installation directions of PART 1, paragraph 1.01.B. - Related Work Specified Elsewhere, this Section, before proceeding.

3.02 INSTALLATION:

- A. Mount articles of hardware at locations and in the manner prescribed in the respective DHI standards specified in PART 1, this Section, unless otherwise specified.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the DIVISION 09 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. All field preparations, such as drilling, cutting, tapping, and countersinking shall be accurately executed to assure precise fitting and adjustment.
- E. Use fasteners of correct size and type with anchoring devices as required by construction conditions, suited to the nature of the attachment substrate, and the duty performance required.
- F. In the course of installation, avoid damage to hardware mechanisms, finishes, and surrounding surfaces; smearing of paints, sealants, and lubricants onto surfaces not intended to receive them; and the admission of foreign matter into chassis and cases of units and their associated preparations.
- G. Seal weather-protection components attached to the exterior sides of doors and frames in place with clear silicone caulk in such a manner as to ensure a continuously filled seam throughout the joinery.
- H. Cut and fit weatherstripping accurately so as to affect the greatest possible continuity of the contact element. Where hardware-compatible extrusions are specified "do not cut," adjust templating of soffit-mounted hardware to suit the extrusion thickness, and mount all such items on the extrusions.
- I. Protection plates shall be installed on visual centers of closed doors. Bottom edges of all such plates shall be flush with bottoms of doors or shall meet top edges of surface-applied door sweeps where they are specified.
- J. At exterior doors, obtain satisfactory operation of the installation, then apply a thin layer of clear silicone caulk under hinge leaves, both door and frame. Remove excess caulk after torquing fasteners.
- K. Adjust door closers immediately upon installation. Adjust in exact conformance with manufacturer's printed instructions. Back-check shall be advanced to reduce shock at dead stop. Latching speed shall be set to assure unassisted positive latching. Readjustment of closers may be required prior to acceptance as directed by the Engineer. Adjust hold open device so door closes with normal use. Hold open device to be engaged only when extra push to the door is applied.
- L. Degrees of swing of doors are given for closers where exact dimensioning, of the installation to achieve the indicated angles, is required.

SECTION 087000 - FINISH HARDWARE: continued

3.03 ADJUSTMENT AND CLEANING:

- A. Check and adjust each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy return to the installation during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
 - 2. Checking and adjustment shall be performed by a certified Architectural Hardware Consultant to ensure proper operation and function of each unit.
- B. Lubricate units only as recommended by their manufacturers.
- C. Remove excess sealants, lubricants, and any other foreign substances, and protect all installations from subsequent damage.
- D. Clean units just prior to final acceptance, with only materials and procedures recommended by their manufacturers.
- E. Maintain the sheets of instruction, layout templates, and any supplementary literature regarding hardware in a readable condition. Transmit to the Engineer all such matter together with all spare parts, specialized tools, and other accessories supplied with the hardware. Also, transmit to the Engineer a copy of the approved hardware schedule. Notify the Engineer in writing that such transmittal has occurred.
- F. Instruct Engineer's maintenance personnel in the proper adjustment and maintenance of door hardware and finishes. Instructions shall be performed by a certified Architectural Hardware Consultant or a qualified representative of the manufacturer.

END OF SECTION 087000

SECTION 089100 - ARCHITECTURAL LOUVERS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Fixed metal wall louvers.
- B. Related Work Specified Elsewhere: The following Sections contain requirements that relate to this Section:
 - 1. DIVISION 23 for electric and electronic control of motor-operated adjustable metal wall louvers.
 - 2. DIVISION 26 for electrical power connections for motor-operated adjustable metal wall louvers.
 - 3. SECTION 079200 for sealants installed in perimeter joints between louver frames and adjoining construction.

1.02 REFERENCES:

- A. Air Movement and Control Association (AMCA):
 - 1. 500-L-1999 - Test Methods for Louvers, Dampers.
 - 2. 511 - Certified Ratings Program for Air Control Devices.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. 2605-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American Standard for Testing and Materials (ASTM):
 - 1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 2. A526/A526M - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
 - 3. A527/A527M - Steel sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
 - 4. A780 - Practice for Repair of Damaged Hot-Dip Galvanized Coatings.
 - 5. B209/B209M - Aluminum and Aluminum-Alloy Sheet and Plate.
 - 6. B221/B221M - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - 7. C578 - Preformed, Cellular Polystyrene Thermal Insulation.
 - 8. C612 - Mineral Fiber Block Thermal Insulation.
 - 9. E90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
 - 10. E413 - Classification for Determination of Sound Transmission Class.
- D. American Welding Society (AWS):
 - 1. D1.2 - Structural Welding Code - Aluminum.
 - 2. D1.3 - Structural Welding Code - Sheet Steel.
- E. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. Metal Finishes Manual for Architectural and Metal Products, 1988.
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):
 - 1. Architectural Sheet Metal Manual, 2003.

1.03 DEFINITIONS:

- A. Louver Terminology: Refer to Air Movement and Control Association (AMCA) 501 for definitions of terms for metal louvers not otherwise defined in this Section or in referenced standards.

SECTION 089100 - ARCHITECTURAL LOUVERS: continued

1.04 PERFORMANCE REQUIREMENTS:

- A. Structural Performance: Engineer, fabricate, and install exterior metal wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.
- B. Wind Load: Uniform pressure (velocity pressure) of 20 lbf per sq. ft. (960 Pa), acting inwards or outwards.
- C. Wind Load: Uniform pressures (velocity pressures) indicated on Drawings, acting inwards or outwards.
- D. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 100°F (56°C).
- E. Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturer's stock units of height and width indicated. Test units according to AMCA 500.
 - 1. Perform testing on unpainted, cleaned, degreased units.
 - 2. Perform water-penetration testing on louvers without screens.

1.05 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Product data for each type of product specified.
- C. Shop Drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, and spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.
 - 1. For installed products indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.
- D. Wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring.
- E. Samples for initial selection in the form of manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- F. Samples for verification of each type of finish required, prepared on samples of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- G. Product test reports evidencing compliance of units with performance requirements indicated.
- H. Product certificates signed by louver manufacturers certifying that their products comply with the specified requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500 and complying with the AMCA Certified Ratings Program.
- I. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.

1.06 QUALITY ASSURANCE:

- A. Single-Source Responsibility: Obtain louvers from one source and by a single manufacturer where alike regarding type, design, and factory-applied color finish.

SECTION 089100 - ARCHITECTURAL LOUVERS: continued

- B. Welding Standards: Comply with applicable provisions of AWS D1.2 and D1.3.
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- C. Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of louvers similar to this Project in material, design, and extent and that have a record of successful in-service performance.
- D. SMACNA Standard: Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.
- E. UL and NEMA Compliance: Provide motors and related components for motor-operated adjustable louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.07 PROJECT CONDITIONS:

- A. Field Measurements: Check actual louver openings by accurate field measurements before fabrication, and show recorded measurements on final Shop Drawings.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fixed Metal Wall Louvers:
 - a. Airolite Co.
 - b. Airstream Products Div., Penn Ventilator Co., Inc.
 - c. All-Lite Louver Co.
 - d. American Warming and Ventilating, Inc.
 - e. Arrow United Industries.
 - f. Construction Specialties, Inc.
 - g. Ruskin Mfg., Tomkins Industries, Inc.

2.02 MATERIALS:

- A. Aluminum Extrusions: ASTM B221/B221M, Alloy 6063-T5 or T-52.
- B. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are corrosive or incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.
- C. Anchors and Inserts: Of type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.
- D. Bituminous Paint: Cold-applied asphalt mastic without asbestos fibers.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94% zinc dust by weight.

SECTION 089100 - ARCHITECTURAL LOUVERS: continued

2.03 FABRICATION, GENERAL:

- A. General: Fabricate louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.
- B. Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Maintain equal louver blade spacing to produce uniform appearance.
- E. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.
- F. Include supports, anchorages, and accessories required for complete assembly.
- G. Provide vertical mullions of type and at spacing's indicated but not more than recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less. At horizontal joints between louver units, provide horizontal mullions except where continuous vertical assemblies are indicated.
- H. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.
- I. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary:
 - 1. With fillet welds, concealed from view.
 - 2. With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with louver manufacturer.

2.04 FIXED, EXTRUDED-ALUMINUM WALL LOUVER:

- A. Horizontal, Drainable, Fixed-Blade Louvers: Extruded-aluminum frames and louver blades, designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions, complying with the following requirements:
 - 1. Louver Depth: 4 inches (100 mm) for wall louvers.
 - 2. Frame Thickness: 0.081 inch (2.06 mm).
 - 3. Blade Thickness: 0.081 inch (2.06 mm).
 - 4. Blade Angle: 37 degrees.
 - 5. Performance Requirements: As follows, determined by testing units 48 inches (1220 mm) wide by 48 inches (1220 mm) high per AMCA 500:
 - a. Free Area: Not less than 50%.
 - b. Static Pressure Loss: Not more than 0.14 inch wg (35 Pa) at an airflow of 800 fpm (4.57 m/s) free area intake velocity.
 - c. Water Penetration: Not more than 0.01 oz. per sq. ft. (3.1 g/sq. m) of free area at an airflow of 873 fpm free area velocity when tested for 15 minutes.
 - 6. AMCA Seal: Mark units with the AMCA Certified Ratings Seal.

2.05 LOUVER SCREENS:

- A. General: Provide louvers with screens at locations indicated.
- B. General: Provide each exterior louver with louver screens complying with the following requirements:
 - 1. Screen Location for Louvers: Interior face.
 - 2. Screening Type: Insect screening.

SECTION 089100 - ARCHITECTURAL LOUVERS: continued

- C. Secure screens to louver frames with stainless-steel machine screws, spaced 6 inches (150 mm) maximum from each corner and at 12 inches (300 mm) o.c. between.
- D. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.
 - 2. Finish: Same finish as louver.
- E. Louver Screening: Fit louver screen frames with screening covering louver openings and complying with the following requirements:
 - 1. Insect Screening: 18 by 18 (1.4 by 1.4 mm) mesh formed with 0.009-inch (0.23-mm) diameter 70% PVDF coated aluminum wire.

2.06 FINISHES, GENERAL:

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
 - 1. Finish louvers after assembly.

2.07 ALUMINUM FINISHES:

- A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70% PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect/Engineer from manufacturer's full range.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION:

- A. Locate and place louver units plumb, level, 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. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make required alterations, and refinish entire unit, or provide new units.
- F. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where required to make louver joints weathertight. Comply with SECTION 079200 for sealants applied during installation of louver.

SECTION 089100 - ARCHITECTURAL LOUVERS: continued

3.03 ADJUSTING AND PROTECTION:

- A. Protect louvers and vents from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.
- B. Restore louvers and vents damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, remove damaged units and replace with new units. Clean and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.
- C. Test operation of adjustable wall louvers and adjust as needed to produce fully functioning units that comply with requirements.

3.04 CLEANING:

- A. Periodically clean exposed surfaces of louvers and vents that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry.

END OF SECTION 089100

DIVISION 09 - FINISHES

SECTION 096510 - RESILIENT WALL BASE

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Rubber base.

1.02 REFERENCES:

- A. American Society for Testing and Materials (ASTM):
 - 1. D2240 - Test Method for Rubber Property - Durometer Hardness.
 - 2. F710 - Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
 - 3. F1066 - Vinyl Composition Floor Tile.
 - 4. F1861 - Resilient Wall Base.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Product Data: For each type of product specified.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors available for each type of product indicated.
- D. Samples for Verification:
 - 1. Manufacturer's standard-size samples, but not less than 12 inches (300 mm) long, of each resilient accessory color and pattern specified.
- E. Product Certificates: Signed by manufacturers of resilient products certifying that each product furnished complies with requirements.

1.04 QUALITY ASSURANCE:

- A. Installer Qualifications: Engage an experienced installer to perform Work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver products to Project Site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90°F (10 and 32°C).
- C. Store tiles on flat surfaces.
- D. Move products into spaces where they will be installed at least 72 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.06 PROJECT CONDITIONS:

- A. Maintain a temperature of not less than 70°F (21°C) or more than 95°F (35°C) in spaces to receive products for at least 72 hours before installation, during installation, and for at least

SECTION 096510 - RESILIENT WALL BASE: continued

48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55°F (13°C) or more than 95°F (35°C).

- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
- D. Install tiles and accessories after other finishing operations, including painting, have been completed.
- E. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

1.07 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.
 - 2. Furnish not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.
 - 3. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Resilient Tile Flooring Schedule at the end of PART 3.

2.02 RESILIENT ACCESSORIES:

- A. Rubber Wall Base: Products complying with ASTM F1861, Type TS (Thermoset).

2.03 INSTALLATION ACCESSORIES:

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

SECTION 096510 - RESILIENT WALL BASE: continued

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 RESILIENT ACCESSORY INSTALLATION:

- A. General: Install resilient accessories according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework, and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 3. Do not stretch base during installation.
 - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 5. Install premolded outside and inside corners before installing straight pieces.
 - 6. Form outside corners on job from straight pieces of maximum lengths possible, without whitening at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
- C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.
- D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.04 CLEANING AND PROTECTING:

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by flooring manufacturer.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
 - 1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive and surface blemishes, if recommended in writing by manufacturer.
 - a. Use commercially available product acceptable to flooring manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
 - 2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Achievement of Full Operations.

SECTION 096510 - RESILIENT WALL BASE: continued

3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Achievement of Full Operations in each area of Project. Clean products according to manufacturer's written recommendations.
 1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.
 2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with Owner's maintenance program.

3.05 RESILIENT TILE FLOORING SCHEDULE:

- A. Rubber Wall Base: Where this designation is indicated, provide rubber wall base complying with the following:
 1. Color and Pattern: As selected by Engineer/Architect from manufacturer's full range of colors and patterns produced for rubber wall base complying with requirements indicated.
 2. Style: Cove with top-set toe.
 3. Minimum Thickness: 0.120 inch (3.0 mm).
 4. Height: 4 inches (101.6 mm).
 5. Lengths: Cut lengths 48 inches (1,219.2 mm) long or coils in lengths standard with manufacturer, but not less than 96 feet (29.26 m).
 6. Outside Corners: Premolded.
 7. Inside Corners: Premolded.
 8. Ends: Premolded.
 9. Surface: Smooth.

END OF SECTION 096510

DIVISION 09 - FINISHES

SECTION 099000 - PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes coating of exterior and interior surfaces throughout the Project and which are listed in PART 2, with systems specified on "coating system" sheets at the end of this Section.
- B. Coating systems include surface preparation, prime coat (first coat), finish coats (second and third coats), inspection, cleaning, and touch-up of surfaces and equipment. Shop preparation, prime coat, and finish coats to be shop-applied, may be specified elsewhere or referenced to this Section so that a complete system is specified and coordinated.
 - 1. Where surface preparation and first (prime) coat are specified in other sections to be shop-applied, such as for structural steel, hollow metal doors or equipment, only the touch-up and finish coats are a part of field painting. Surface preparation is the required degree of preparation prior to application of first (prime) coat regardless if done in shop or field.
 - 2. If materials are provided without shop primer such as miscellaneous steel or sheet metal, then surface preparation, first, second, and third coats are a part of field painting.
 - 3. Concealed surfaces are generally not required to have finish-coats unless otherwise specified, but prime coat should be applied and touched up prior to concealment.
 - 4. Where Equipment and Materials are provided with shop-applied finished coating system, only touch-up is a part of field painting.
 - 5. Refer to applicable sections to determine whether surface preparation and first coat, or complete coating system, is to be shop-applied.
- C. Related Work Specified Elsewhere:
 - 1. Shop Painting and Coatings: All applicable Divisions.
 - 2. Factory Prefinished Items: All applicable Divisions.
- D. Colors:
 - 1. Colors of finish coatings shall match accepted color Samples.
 - 2. When second and finish coats of a system are of same type, tint or use an alternate color on second coat to enable visual coverage inspection of the third coat. When first and second coats only are specified and are of same or different types, tint or use an alternate color on first coat to enable visual coverage inspection of the second coat.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American National Standards Institute (ANSI):
 - a. A13.1 - Scheme for the Identification of Piping Systems.
 - b. Z53.1 - Safety Color Code for Marking Physical Hazards.
 - 2. American Society for Testing and Materials (ASTM):
 - a. D2092 - Guide for Treatment of Zinc-Coated (Galvanized) Steel Surfaces for Painting.
 - b. D4258 - Surface Cleaning Concrete for Coating.
 - c. D4259 - Abrading Concrete.
 - d. D4260 - Acid Etching Concrete.
 - e. D4261 - Surface Cleaning Concrete Unit Masonry for Coating.

SECTION 099000 - PROTECTIVE COATINGS: continued

3. Society for Protective Coatings (SSPC) Surface Preparation Specifications:
 - a. SP1 - Solvent Cleaning: Removes oil, grease, soil, drawing and cutting compounds, and other soluble contaminants.
 - b. SP2 - Hand Tool Cleaning: Remove loose material. Not intended to remove adherent mill scale, rust, and paint.
 - c. SP3 - Power Tool Cleaning: Removes loose material. Not intended to remove all scale or rust.
 - d. SP5 - White Metal Blast Cleaning: Removes all scale, rust, foreign matter. Leaves surface gray-white uniform metallic color.
 - e. SP6 - Commercial Blast Cleaning: Two-thirds of every nine square inches free of all visible residues; remainder only light discoloration.
 - f. SP7 - Brush-Off Blast Cleaning: Removes only loose material, remaining surface tight and abraded to give anchor pattern.
 - g. SP10 - Near-White Blast Cleaning: At least 95% of every nine square inches shall be free of all visible residues.
 - h. SP11 - Power Tool Cleaning to Bare Metal.
 - i. SP12 - Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior to Recoating.
 - j. SP13 - Surface Preparation of Concrete.
4. National Sanitation Foundation (NSF):
 - a. 61 - Drinking Water Treatment Chemicals - Health Effects.

1.03 SUBMITTALS:

- A. Submit as specified.
- B. Includes, but not limited to, the following:
 1. Schedule of products and paint systems to be used. Schedule shall include the following information:
 - a. Surfaces for system to be applied.
 - b. Surface preparation method and degree of cleanliness.
 - c. Product manufacturer, name, and number.
 - d. Method of application.
 - e. Dry film mil thickness per coat of coating to be applied.
 2. Color charts for selection and acceptance.
 3. Technical and material safety data sheets.
 4. Certification(s) by coating manufacturer(s) that all coatings are suitable for service intended as stated on each coating system sheet. If manufacturer has an equivalent product as that specified, and it is suitable for the intended purpose, Contractor shall submit the comparative product data for approval at no increase in cost, and state reasons for substitution.
 5. Contractor shall certify in writing to the Engineer's Consultant that applicators have previously applied all the systems in this Specification and have the ability and equipment to prepare the surfaces and apply the coatings correctly.
 - a. Submittals for industrial maintenance coatings shall be prepared by, or have assistance in preparation of, a corrosion engineer or industrial coatings technical representative of the coating manufacturer.

SECTION 099000 - PROTECTIVE COATINGS: continued

1.04 QUALITY ASSURANCE:

- A. Include on label of container:
 - 1. Manufacturer's name, product name, and number.
 - 2. Type of paint and generic name.
 - 3. Color name and number.
 - 4. Storage and temperature limits.
 - 5. Mixing and application instructions, including requirements for precautions which must be taken.
 - 6. Drying, recoat, or curing time.
- B. Prepainting Conference:
 - 1. Before Project field painting starts, representatives for the Owner, Contractor, coating applicator, and coating manufacturer's technical representative shall meet with Engineer.
 - 2. Agenda for the meeting will include details of surface preparations and coating systems to ensure understanding and agreement by all parties for compliance.
- C. A coating report shall be completed daily by Contractor at each phase of the coating system starting with surface preparation. These shall be submitted on the form attached at end of this Section.
- D. In the event a problem occurs with coating system, surface preparation, or application, Contractor shall require coating applicator and coating manufacturer's technical representative to promptly investigate the problem and submit results to Engineer.
- E. Specified VOC shall mean unthinned maximum VOC certified by manufacturer. VOC content as a result of thinning shall not exceed that allowed by federal or local environmental regulations.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Delivery of Materials:
 - 1. Deliver in sealed containers with labels and information legible and intact. Containers shall also have correct labels with required information.
 - 2. Allow sufficient time for testing if required.
- B. Storage of Materials:
 - 1. Store only acceptable materials on Project Site.
 - 2. Provide separate area and suitable containers for storage of coatings and related coating equipment.
 - 3. Dispose of used or leftover containers, thinners, rags, brushes, and rollers in accordance with applicable regulations.

1.06 REGULATORY REQUIREMENTS:

- A. In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the U.S. EPA and the local and regional jurisdictions. Notify Engineer of any coating specified herein that fails to conform to the requirements for the location of the Project or location of application.
- B. Lead Content: Use only coatings that are totally lead free except for zinc-rich primers which shall not have a lead content over 0.06% by weight of nonvolatile content.
- C. Chromate Content: Do not use coatings containing zinc-chromate or strontium chromate.
- D. Asbestos Content: Materials shall not contain asbestos.
- E. Mercury Content: Materials shall not contain mercury or mercury compounds.

SECTION 099000 - PROTECTIVE COATINGS: continued

1.07 PROJECT CONDITIONS:

- A. If spray-applied, paint could contaminate adjacent building surfaces or vehicles near Site. All containment precautions and application methods shall be taken into consideration and implemented to prevent the above from occurring.
- B. Contractor must protect all mechanical equipment, controls, valves, etc., during surface preparation procedures and coating application.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Proprietary names and product numbers are specified in most systems for material identification from these manufacturers:
 - 1. Ameron Protective Coatings Systems Group, Ameron Corp.
 - 2. Carboline Company, Inc.
 - 3. Sauereisen.
 - 4. Sherwin-Williams.
 - 5. Tnemec Company, Inc.

2.02 GENERAL:

- A. Materials furnished for each coating system must be compatible to the substrate.
- B. When unprimed surfaces are to be coated, entire coating system shall be by the same coating manufacturer to assure compatibility of coatings.
- C. When shop-painted surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform Engineer of any unsuitable substrate or coating conditions.

2.03 COATING SYSTEMS:

- A. Specified on the "Protective Coating System" sheets at the end of this Section.

2.04 SURFACES TO BE COATED:

- A. System A-5:
 - 1. Item: Miscellaneous exposed metal (exterior) exposure:
 - a. Reference: DIVISION 05, Architectural and Structural Drawings.
 - b. Location: As indicated.
- B. System E-1:
 - 1. Item: Miscellaneous, Non-galvanized Steel. Interior Exposure:
 - a. Reference: DIVISION 05 and Drawings.
 - b. Location: As indicated.
 - 2. Item: Steel hangers and supports for mechanical equipment, piping and related accessories. Interior Exposure:
 - a. Reference: DIVISION 05 and DIVISION 22.
 - b. Location: As indicated.
- C. System F-3: Electrical Room Walls - Interior Only:
 - 1. Item: Concrete or Concrete Masonry Units (CMU). Interior Exposure:
 - a. Reference: Architectural Drawings.
 - b. Location: As indicated.
- D. System L-4:
 - 1. Item: Aluminum Duct. Interior Exposure:
 - a. Reference: Mechanical Drawings.

SECTION 099000 - PROTECTIVE COATINGS: continued

- b. Location: As indicated.
- E. Item: Fluoride Room CMU Walls and Concrete Ceiling.
 - 1. Provide the following Tnemec system or approved Sherwin Williams or Carboline equal meeting the design criteria listed below:
 - a. Coating System:
 - (1) Surface Preparation: In accordance with SSPC-SP13/NACE 6 to level protrusions and mortar spatter and remove other contaminants.
 - (2) Primer: Series 1254 Epoxoblock WB @ 10.0-20.0 mils D.F.T.
 - (3) Intermediate Coat: Series 280 Tneme-Glaze @ 6.0-12.0 (Horizontal Surfaces and 4.0-8.0 (Vertical Surfaces) mils D.F.T.
 - (4) Finish Coat: Series 282 Tneme-Glaze @ 6.0-12.0 (Horizontal Surfaces and 4.0-8.0 (Vertical Surfaces) mils D.F.T. Total D.F.T. of 22-34 (Horizontal Surfaces) and 18-26 (vertical surfaces) mils minimum.
- F. Item: Fluoride Room Concrete Floor, Equipment Pad and Exterior Chemical Containment Area.
 - 1. Provide the following Tnemec system or approved Sherwin Williams or Carboline equal meeting the design criteria listed below:
 - a. Coating System:
 - (1) Surface Preparation: Allow new cast-in-place concrete to cure a minimum of 28 days at 75°F (24°C). Verify concrete dryness and prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Moisture vapor transmission should not exceed three lbs. per 1,000 sq. ft. in a 24-hour period. Relative humidity should not exceed 80%. Abrasive blast, shot-blast or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers and other contaminants and to provide a minimum ICRI-CSP 5 or greater surface profile. Large cracks, voids and other surface imperfections should be filled with a recommended filler or surfacer.
 - (2) Primer: Series 251SC @ 4.0-12.0 mils D.F.T.
 - (3) Intermediate and Finish Coats: Series 252SC Chembloc MCK System w/fiberglass mat reinforcement per manufacturer's direction @ 80.0-100.0 mils. System Total D.F.T. of 84.0-110.0 mils minimum.
 - (4) Chemical Containment Basin Top Coat ONLY: Series 290 CRU Aliphatic Urethane @ 2.0-3.0 mils D.F.T.

2.05 SURFACES NOT TO BE COATED:

- A. Do not field paint any of the following items unless specifically noted otherwise:
 - 1. Factory finished equipment, except for touch-up. Equipment manufacturer to provide touch-up paint. Field coat shall match existing where applicable.
 - 2. Metal surfaces of aluminum, stainless steel, copper, bronze and similar finished materials, except where noted.
 - 3. Heating and ventilation system, except as noted.
 - 4. Interior and exterior PVC/CPVC and HDPE piping.
 - 5. Rigid Steel Conduit with PVC coating.

SECTION 099000 - PROTECTIVE COATINGS: continued

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Prepare surfaces for each coating system conforming to SSPC or ASTM surface preparation specifications listed.
 - 1. If grease or oils are present, SSPC-SP1 shall precede any other method specified for metal substrates.
 - 2. Remove surface irregularities such as weld spatter, burrs, or sharp edges prior to specified surface preparation.
- B. Depth of profile will be as specified or as recommended by the manufacturer for each system, but in no instance shall it exceed one-third of the total dry film thickness of complete system.
- C. Prepare only those areas which will receive the first coat of the system on the same day.
 - 1. On steel substrates, apply coating before rust bloom forms.
- D. Concrete and masonry surfaces shall be adequately cured prior to coating application.
 - 1. Use surface cleaning methods, followed by mechanical or chemical surface preparation as specified in SSPC-SP13.
 - a. Acid etching (ASTM D4260) shall not be used for vertical surfaces.
 - b. Acid etching shall only be used where:
 - (1) Procedures are in place for removal of acid residues and the handling, containment, and disposal of hazardous materials.
 - (2) Measures for protection of worker health and safety are provided.
- E. For new galvanized steel to be coated, if absence of hexavalent stain inhibitors is not documented, test as described in ASTM D2092, Appendix X2, and remove by one of the methods described therein.

3.02 APPLICATION:

- A. Apply coatings in accordance with coating manufacturer's recommendations.
- B. Use properly designed brushes, rollers, and spray equipment for all applications.
- C. On unprimed surfaces apply first coat of the system the same day as surface preparation.
- D. Dry film thickness of each system shall meet the minimum specified. Maximum dry film thickness shall not exceed the minimum more than 20% or coating manufacturer's requirements if less. Where a dry film thickness range is specified, the range shall not be less than or exceeded.
- E. Shop and field painting shall remain 3 inches (75 mm) away from unprepared surface of any substrate such as areas to be welded or bolted.
- F. Environmental Conditions:
 - 1. Atmospheric temperature must be 50°F (10°C) or higher during application, unless otherwise approved by coating manufacturer. Do not apply coatings when inclement weather or freezing temperature may occur within coating recoat cure times.
 - 2. Wind velocities for exterior applications shall be at a minimum to prevent overspray or fallout and not greater than coating manufacturer's limits.
 - 3. Relative humidity must be less than 85%. The ambient temperature and the temperature of the surface to be painted must be at least 5°F (2.8°C) above the dew point.
 - 4. Provide adequate ventilation in all areas of application to ensure that at no time does the content of air exceed the Threshold Limit Value given on the manufacturer's Material Safety Data Sheets for the specific coatings being applied.
- G. Recoat Time: In the event a coating, such as an epoxy, has exceeded its recoat time limit, prepare the applied coating in accordance with manufacturer's recommendations.

SECTION 099000 - PROTECTIVE COATINGS: continued

H. Protection:

1. Cover or otherwise protect surfaces not to be painted. Remove protective materials when appropriate.
2. Mask, remove, or otherwise protect finish hardware, machined surfaces, grilles, lighting fixtures, and prefinished units as necessary.
3. Provide cover or shields to prevent surface preparation media and coatings from entering orifices in electrical or mechanical Equipment. Where ventilation systems must be kept in operation at time of surface preparation, take precautions to shield intakes and exhausts to prevent the materials from entering system or being dispersed.
4. Provide signs to indicate fresh paint areas.
5. Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, rags, and thinners. Dispose of leftover containers, thinners, rags, brushes, and rollers which cannot be reused in accordance with applicable regulations.
6. Do not remove or paint over Equipment data plates, code stamps on piping, or UL fire-rating labels.

3.03 INSPECTION:

- A. Contractor shall provide and use a wet film gages to check each application approximately every 15 minutes in order to immediately correct film thickness under or over that specified.
- B. Contractor shall provide and use a dry film gage to check each coat mil (mm) thickness when dry, and the total system mil (mm) thickness when completed.
- C. Use holiday or pinhole detector on systems over metal substrates to detect and correct voids when indicated on system sheet.
- D. Furnish a sling psychrometer and perform periodic checks on both relative humidity and temperature limits.
- E. Check air temperature and temperature of the substrate at regular intervals to be certain surface is 5°F (2.8°C) or more above the dew point.

3.04 CLEANING AND REPAIRS:

- A. Remove spilled, dripped, or splattered paint from surfaces.
- B. Touch up and restore damaged finishes to original condition. This includes surface preparation and application of coatings specified.

END OF SECTION 099000

SECTION 099000 - PROTECTIVE COATINGS: continued

COATING REPORT

Contract Name: _____ Contract No.: _____
Coating Contractor: _____ Foreman: _____

Unit or Surface Identification: _____
Unit or Surface Location: Exterior: _____, Interior: _____

Surface Preparation:
Date _____; Air Temp _____ °F; Relative Humidity _____ %
Method of Surface Preparation: _____
Profile achieved _____ mils (if applicable).

Touch-Up:
Date _____; Time _____; Air Temp _____ °F; Surface Temp _____ °F
Relative Humidity _____ %; Dew Point _____ °F
Coating Used _____; Dry Film Obtained _____ mils.

First Coat:
Date _____; Time _____; Air Temp _____ °F; Surface Temp _____ °F
Relative Humidity _____ %; Dew Point _____ °F
Coating Used _____; Dry Time Before Recoat _____ hrs.
Dry Film Obtained _____ mils.

Second Coat:
Date _____; Time _____; Air Temp _____ °F; Surface Temp _____ °F
Relative Humidity _____ %; Dew Point _____ °F
Coating Used _____; Dry Time Before Recoat _____ hrs.
Dry Film Obtained _____ mils.

Third Coat:
Date _____; Time _____; Air Temp _____ °F; Surface Temp _____ °F
Relative Humidity _____ %; Dew Point _____ °F
Coating Used _____; Dry Film Obtained _____ mils.

SECTION 099000 - PROTECTIVE COATINGS: continued

| | | | | |
|---|----------------------------------|----------------------------------|-----------------------------------|--|
| <p>Burns & McDonnell Engineering Company Engineers – Architects – Consultants Kansas City, Missouri</p> | | PROTECTIVE COATING SYSTEM | | |
| | | System: A-5 | | |
| <p>SERVICE: Steel - Moderate to Severe Exposure (Nonimmersion)</p> <p>Surface Preparation: Shop: SSPC-SP6 and profile depth 1.5 to 2.0 mils (0.038 to 0.051 mm). Field: SSPC-SP2 and SP3. Clean and dry.</p> <p>First Coat: High solids polyamine or polyamide epoxy with minimum 67% solids by volume. Apply at 5.0 to 8.0 mils (0.127 to 0.203 mm) dry film thickness.</p> <p>Second Coat: High solids aliphatic acrylic polyurethane gloss enamel with minimum 52% solids by volume. Apply at 2.0 mils (0.051 mm) dry film thickness.</p> <p>System Total: Minimum 7.0 mils (0.178 mm) dry film thickness.</p> <p>Volatile Organic Content: Maximum 3.5 lb./gal (425 g/L).</p> | | | | |
| COATING MANUFACTURER | | PRODUCT DESIGNATION | | |
| | FIRST COAT | TOUCH UP | SECOND COAT | |
| Ameron | Amerlock 2 or 400 | Same as first coat | Amercoat 450 H | |
| Carboline | Carboguard 890 | Same as first coat | Carbothane 134 HG | |
| Sherwin-Williams | Macropoxy 646 B58-600/B58V600 | Same as first coat | HS Polyurethane B65-300 Series | |
| Tnemec | Epoxoline II-N69 | Same as first coat | Endura-Shield II, Series 1074 | |

SECTION 099000 - PROTECTIVE COATINGS: continued

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|---|-----------------------------------|----------------------------------|--------------------|
| Burns & McDonnell Engineering Company Engineers – Architects – Consultants Kansas City, Missouri | | PROTECTIVE COATING SYSTEM | |
| | | System: E-1 | |
| <p><u>SERVICE:</u> Steel & Iron - Nonpotable Liquid Immersion, Normal to Severe Exposure. Interior of Tank or Basin. Exterior of Steel, Piping, or Equipment in Tank or Basin.</p> <p>Surface Preparation: Shop or Field First Coat: SSPC-SP5 and profile depth of 1.5 to 2.5 mils (0.038 to 0.064 mm). Field Touch-Up (of Shop-applied first coat): Same as for First Coat.</p> <p>First Coat: High solids amine or polyamidoamine epoxy coating with minimum 67% solids by volume. Apply at 5.0 mils (0.127 mm) dry film thickness.</p> <p>Second Coat: Same as first coat.</p> <p>System Total: Minimum 10.0 mils (0.254 mm) dry film thickness. Check for voids with holiday or pinhole detector.</p> <p>Volatile Organic Content: Maximum 2.8 lb./gal (340 g/L).</p> | | | |
| COATING MANUFACTURER | | PRODUCT DESIGNATION | |
| | FIRST COAT | TOUCH UP | SECOND COAT |
| Ameron | Amerlock 2 or 400 | Same as first coat | Same as first coat |
| Carboline | Carboguard 890 | Same as first coat | Same as first coat |
| Sherwin-Williams | Dura-Plate 235 B67-235/B67V235 | Same as first coat | Same as first coat |
| Tnemec | Epoxoline II Series N69 | Same as first coat | Same as first coat |

SECTION 099000 - PROTECTIVE COATINGS: continued

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|--|--|--|--|
| <p>Burns & McDonnell Engineering Company Engineers – Architects – Consultants Kansas City, Missouri</p> | | <p>PROTECTIVE COATING SYSTEM</p> | |
| <p><u>SERVICE:</u> Concrete, Concrete Masonry Units (CMU) –Severe Exposure (Nonimmersion) Interior</p> <p>Surface Preparation: Concrete: ASTM D4258. Fill pits in concrete with patching compound as recommended by coating manufacturer. CMU: ASTM D4261, clean and dry.</p> <p>First Coat: Concrete: High solids epoxy with minimum 75% solids by volume. Apply at 5.0 to 8.0 mils (0.127 to 0.203 mm) dry film thickness. CMU: High solids epoxy block filler with minimum 60% solids by volume. Apply at 10.0 to 20.0 mils (0.254 to 0.508 mm) dry film thickness and as required to fill pores.</p> <p>Second Coat: Concrete & CMU: High solids epoxy with minimum 75% solids by volume. Apply at 5.0 to 8.0 mils (0.127 to 0.203 mm) dry film thickness. Semigloss or gloss finish.</p> <p>System Total: Concrete: Minimum 10.0 mils (0.254 mm) dry film thickness. Minimum 15.0 mils (0.381mm) dry film thickness.</p> <p>Volatile Organic Content: Maximum 3.5 lb/gal (425 g/L).</p> | | <p>System: F-3</p> | |
| <p>COATING MANUFACTURER</p> | <p>PRODUCT DESIGNATION</p> | | |
| <p>Concrete Ameron Carboline Ceilcote International Sherwin-Williams Tnemec</p> <p>CMU Ameron Carboline Ceilcote International Sherwin-Williams Tnemec</p> | <p>FIRST COAT</p> <p>Amerlock 2 or 400 Carboguard 890 600 Flakeline Interseal 670 HS Macropoxy HS B58W400 Series Ceramlon ENV Series 84</p> <p>Amerlock 400 BF Sanitile 600 610 Ceilpatch Intergard 475 HS Kem CatiCoat HS B42W400 Epoxoblock WB 1254</p> | <p>SECOND COAT</p> <p>Amerlock 2 or 400 Carboguard 890 600 Flakeline Interseal 670 HS Macropoxy HS B58W 400 Series Ceramlon ENV Series 84</p> <p>Amerlock 2 or 400 Carboguard 890 600 Flakeline Interzone 954 Macropoxy HS B58W 400 Series Ceramlon ENV Series 84</p> | |

SECTION 099000 - PROTECTIVE COATINGS: continued

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|---|----------------------------------|----------------------------------|-------------------------|
| Burns & McDonnell Engineering Company Engineers – Architects – Consultants Kansas City, Missouri | | PROTECTIVE COATING SYSTEM | |
| | | System: L-4 | |
| <p><u>SERVICE:</u> Fiberglass-Reinforced (FRP) and Polyvinyl Chloride (PVC) Piping – Interior/Exterior Exposure (Nonimmersion)</p> <p>Surface Preparation: Field First Coat: Sand lightly. Clean and dry.</p> <p>First Coat: High build polyamide epoxy with minimum 50% solids by volume. Apply at 5.0 mils (0.127 mm) dry film thickness.</p> <p>Second Coat (Interior): None required.</p> <p>Second Coat (Exterior): High solids aliphatic acrylic polyurethane gloss enamel with minimum 52% solids by volume. Apply at 2.0 mils (0.051 mm) dry film thickness.</p> <p>System Total: Interior: Minimum 5.0 mils (0.127 mm) dry film thickness. Exterior: Minimum 7.0 mils (0.178 mm) dry film thickness.</p> <p>Volatile Organic Content: Maximum 3.5 lb/gal (425 g/L)</p> | | | |
| COATING MANUFACTURER | | PRODUCT DESIGNATION | |
| | | FIRST COAT | SECOND COAT EXT. |
| Ameron | Amercoat 385 | Amercoat 450 H | |
| Carboline | Carboguard 893 SG | Carbothane134 HG | |
| Ceilcote | 650FDA Ceilgard | 477 Ceilgard | |
| International | Intergard 475 HS | Interthane 990 Series | |
| Keeler & Long | Kolor-Poxy Primer KL3200 | Acrythane Enamel KLYC1 Series | |
| Sherwin-Williams | Macropoxy 646 B58 W400 Series | Acrolon 218 HS B65-600 Series | |
| Tnemec | High Build Epoxoline 66 | Endura-Shield II - Series 1074 | |

DIVISION 10 - SPECIALTIES

SECTION 104400 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection accessories.

1.02 REFERENCES:

- A. American Architectural Manufacturers Association (AAMA):
 - 1. 603.8 - Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum.
 - 2. 606.1 - Voluntary Guide Specifications and Inspection Methods for Integrate Color Anodic Finishes for Architectural Aluminum.
 - 3. 607.1 - Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
 - 4. 608.1 - Voluntary Guide Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.
- B. International Fire Code.
- C. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. Metal Finishes Manual for Architectural and Metal Products.
- D. National Fire Protection Association (NFPA):
 - 1. 10 - Standard for Portable Fire Extinguishers.
- E. Underwriter's Laboratory (UL):
 - 1. Fire Protection Equipment Directory.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Fire Extinguishers: Include rating and classification.

1.04 QUALITY ASSURANCE:

- A. Source Limitations: Obtain fire extinguishers through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide extinguishers listed and labeled by FM.
 - 2. Provide UL listed or FM approved fire extinguishers.

SECTION 104400 - FIRE-PROTECTION SPECIALTIES: continued

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Portable Fire Extinguishers:
 - a. Amerex Corporation.
 - b. Ansul Incorporated.
 - c. Badger; div. of Figgie Fire Protection Systems.
 - d. Buckeye Fire Equipment Company.
 - e. Fire-End & Croker Corporation.
 - f. General Fire Extinguisher Corporation.
 - g. J.L. Industries, Inc.
 - h. Kidde: Walter Kidde, The Fire Extinguisher Co.
 - i. Larsen's Manufacturing Company.
 - j. Modern Metal Products; div. of Technico.
 - k. Moon/American, Inc.
 - l. Pem All; div. of Pem Systems, Inc.
 - m. Potter-Roemer; div. of Smith Industries, Inc.
 - n. Samson Products, Inc.
 - o. Watrous; div. of American Specialties, Inc.

2.02 PORTABLE FIRE EXTINGUISHERS:

- A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.
- B. Multipurpose Dry-Chemical Type:
 - 1. UL or FM-rated 2-A:10:B:C, 5-lb. (2.3-kg) nominal capacity, in enameled-steel container.

2.03 ACCESSORIES:

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.
 - 1. Provide brackets for extinguishers.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Engineer/Architect.
 - 1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.

SECTION 104400 - FIRE-PROTECTION SPECIALTIES: continued

- B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Fasten mounting brackets to structure, square and plumb.
 - 2. Provide service tag on extinguisher after field inspection.

3.03 ADJUSTING, CLEANING, AND PROTECTION:

- A. Provide final protection and maintain conditions that ensure that fire extinguishers are without damage or deterioration at the time of Achievement of Full Operations.

END OF SECTION 104400

DIVISION 22 - PLUMBING

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. ASTM International (ASTM):
 - a. ASTM A53/A53M - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - b. ASTM C1107/C1107M - Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - c. ASTM D1785 - Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

1.04 ACTION SUBMITTALS:

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

PART 2 - PRODUCTS

2.01 SLEEVES:

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A53/A53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.02 STACK-SLEEVE FITTINGS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING: continued

2.03 SLEEVE-SEAL SYSTEMS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metraflex Company (The).
 - 2. Pipeline Seal and Insulator, Inc.
 - 3. PSI-Thunderline/Link-Seal.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Plastic.
 - 3. Connecting Bolts and Nuts: Stainless steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.04 GROUT:

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5,000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION:

- A. Install sleeves for piping passing through concrete and masonry walls, concrete floor and roof slabs.
- B. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and piping
- C. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25 mm) annular clear space between sleeve and piping for installing mechanical sleeve seals.
- D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. The sleeve shall be two pipe sizes greater than the pipe passing through the wall.
 - a. Exception: CPVC piping installed for the purpose of water distribution piping unless required by the manufacturer's instructions.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- E. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in DIVISION 07.

3.02 STACK-SLEEVE-FITTING INSTALLATION:

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING: continued

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and piping.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in DIVISION 07.
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

3.03 SLEEVE-SEAL-SYSTEM INSTALLATION:

- A. Select sleeves of size large enough to provide 1-inch (25 mm) annular clear space between sleeve and piping for installing mechanical sleeve seals
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE AND SLEEVE-SEAL SCHEDULE:

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system. Seal pipe penetrations using mechanical sleeve seals.
 2. Exterior-Wall Pipe Penetrations, aboveground.
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system. Seal pipe penetrations using mechanical sleeve seals.
 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system. Seal pipe penetrations using mechanical sleeve seals.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. Section Includes:
 - 1. Escutcheons.
- 1.03 ACTION SUBMITTALS:
- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

- 2.01 ESCUTCHEONS:
- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
 - B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 - EXECUTION

- 3.01 INSTALLATION:
- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
 - B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - c. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass with polished, chrome-plated or rough-brass finish.
 - d. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
- 3.02 FIELD QUALITY CONTROL:
- A. Replace broken and damaged escutcheons using new materials.

END OF SECTION 220518

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes:
 - 1. Bronze ball valves.
 - 2. Iron lug style butterfly valves.
 - 3. Bronze gate valves.
- B. Related Sections:
 - 1. DIVISION 22 Plumbing Piping Sections for specialty valves applicable to those sections only.
 - 2. SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT for valve tags and schedules.

1.03 REFERENCE STANDARDS:

- A. Applicable Standards (Latest Edition):
 - 1. ASME International (ASME):
 - a. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
 - b. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - c. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
 - d. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - e. ASME B16.34 - Valves - Flanged, Threaded, and Welding End.
 - f. ASME B31.9 - Building Services Piping.
 - 2. ASTM International (ASTM):
 - a. ASTM A126 - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - b. ASTM A536 - Specification for Ductile Iron Castings.
 - c. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications
 - 3. Manufacturers Standardization Society of The Valve and Fittings Industry, Inc. (MSS):
 - a. MSS SP-45 - Bypass and Drain Connections.
 - b. MSS SP-67 - Butterfly Valves.
 - c. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - d. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
 - e. MSS SP-110 - Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
 - 4. NSF International (NSF):
 - a. NSF 61 - Drinking Water System Components - Health Effects.
 - b. NSF 372 - Drinking Water System Components - Lead Content.

1.04 DEFINITIONS:

- A. CWP: Cold working pressure.
- B. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- C. SWP: Steam working pressure.

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING: continued

1.05 SUBMITTALS:

- A. Product Data: For each type of valve indicated.

1.06 QUALITY ASSURANCE:

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES:

- A. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
- B. Ferrous Valves NPW 2-1/2 (DN 64) and larger with flanged ends, unless otherwise indicated.
- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping, unless otherwise indicated.
- E. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Hand lever: For quarter-turn valves NPS 6 (DN 150) and smaller.
- F. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- G. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- H. Valve Bypass and Drain Connections: MSS SP-45.

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING: continued

2.02 SILICON BRONZE BALL VALVES:

- A. Two-Piece, Regular-Port, Silicon Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. NIBCO INC.
 - d. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. Maximum Pressure/Temperature Rating: 100 psig at 300°F.
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded or Solder.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel.
 - j. Port: Regular.

2.03 BRONZE GATE VALVES:

- A. Class 125, NRS Silicon Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig (1380 kPa).
 - c. Body Material: ASTM B584, silicon bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron , bronze, or aluminum.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING: continued

- B. Operate valves in positions from fully open to fully close. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION:

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:

3.03 ADJUSTING:

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS:

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Butterfly Valve Dead-End Service: (Lug) type.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE:

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two-piece, regular port, bronze with stainless-steel trim.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron, Lug Type Butterfly Valves: 200 CWP, NBR seat, ductile-iron disc.

END OF SECTION 020523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes:
 1. Metal pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Fiberglass pipe hangers.
 4. Metal framing systems.
 5. Fiberglass strut systems.
 6. Thermal-hanger shield inserts.
 7. Fastener systems.
 8. Pipe stands.
 9. Pipe positioning systems.
 10. Equipment supports.

1.03 REFERENCE STANDARDS:

- A. Applicable Standards (Latest Edition):
 1. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
 - a. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.
 2. American Welding Society (AWS):
 - a. AWS D1.1/D1.1M - Structural Welding Code - Steel.
 3. ASME International (ASME):
 - a. ASME B31.9 - Building Services Piping.
 4. ASTM International (ASTM):
 - a. ASTM A36/A36M - Specification for Carbon Structural Steel.
 - b. ASTM A780 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - c. ASTM C1107 - Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 5. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - a. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
 - b. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.
 - c. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 6. Metal Framing Manufacturers Association, Inc. (MFMA):
 - a. MFMA-4 - Metal Framing Standards Publication.
 - b. MFMA-103 - Guidelines for the Use of Metal Framing.

1.04 DEFINITIONS:

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

1.05 PERFORMANCE REQUIREMENTS:

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:
continued

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 1.06 SUBMITTALS:
- A. Product Data: For each type of product indicated.
 - B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 1. Metal framing systems.
 2. Fiberglass strut systems.
 3. Pipe stands.
 4. Equipment supports.
 - C. Welding Procedure Specification (WPS) and Welder Performance Qualification Record (WPQR)
- 1.07 QUALITY ASSURANCE:
- A. Structural Steel Welding Qualifications: Qualify welding procedures, welders, and welding operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - B. Pipe Welding Qualifications: Weld piping in accordance with qualified procedures using performance qualified welders and welding operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

- 2.01 METAL PIPE HANGERS AND SUPPORTS:
- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58 (except as noted in PART 3 - EXECUTION), factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- 2.02 TRAPEZE PIPE HANGERS:
- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.
- 2.03 FIBERGLASS PIPE HANGERS:
- A. Clevis-Type, Fiberglass Pipe Hangers:
 1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
 2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass or stainless steel.
 - B. Strap-Type, Fiberglass Pipe Hangers:

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:
continued

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.
- C. Provide vinyl ester resin for fiberglass spipe hangers.

2.04 METAL FRAMING SYSTEMS:

- A. MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.
 - b. Flex-Strut Inc.
 - c. Powerstrut Corp.
 - d. Unistrut Corporation; Tyco International, Ltd.
 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 3. Standard: MFMA-4.
 4. Channels: Continuous slotted steel channel with inturned lips.
 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
 7. Paint Coating: As specified in DIVISION 9 – High Performance Coatings.

2.05 FIBERGLASS STRUT SYSTEMS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Champion Fiberglass, Inc.
 2. Cooper B-Line, Inc.
 3. SEASAFE, INC.; a Gibraltar Industries Company.
- B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
1. Channels: Continuous slotted fiberglass or other plastic channel with inturned lips.
 2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of fiberglass or stainless steel.
- C. Provide vinyl ester resin for fiberglass strut systems.

2.06 THERMAL-HANGER SHIELD INSERTS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carpenter & Paterson, Inc.
 2. PHS Industries, Inc.
 3. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig (688-kPa) or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:
continued

- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C533, Type I calcium silicate with 100-psig (688-kPa); ASTM C552, Type II cellular glass with 100-psig (688-kPa) or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.07 FASTENER SYSTEMS:

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.08 PIPE STANDS:

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

2.09 EQUIPMENT SUPPORTS:

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS:

- A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5,000-psi (34.5-Mpa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION:

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. The following figure types given in Figure 1 of MSS SP-69 will not be acceptable: Types 5, 6, 7, 9, 10, 11, 12, 16, 19, 20, 23, 25, 27, 28, 29, and 30. However, Types 7, 9, 10, 10, 11, 19, and 23 may be used for nonferrous and plastic piping systems 2 inches and smaller.
- C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:
continued

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- D. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- F. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- G. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- H. Fastener System Installation:
 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Do not use in lightweight concrete or in concrete slabs less than 4 inches thick. Powder actuated fasteners will not be permitted.
- I. Pipe Stand Installation:
 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See DIVISION 07.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:
continued

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- 3.02 EQUIPMENT SUPPORTS:
- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 - B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
 - C. Provide lateral bracing, to prevent swaying, for equipment supports.
- 3.03 METAL FABRICATIONS:
- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
 - B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
 - C. Field Welding: Comply with qualified procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
- 3.04 ADJUSTING:
- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
 - B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).
 - C. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in DIVISION - 09 High Performance Coatings.
 - D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.
- 3.05 HANGER AND SUPPORT SCHEDULE:
- A. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
 - B. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
 - C. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:
continued

- D. Use fiberglass pipe hangers supports for corrosion-resistant attachments for hostile environment applications.
- E. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Exception: The following figure types given in Figure 1 of MSS SP-69 will not be acceptable: Types 5, 6, 7, 9, 10, 11, and 12. However, Types 7, 9, 10, and 11 may be used for nonferrous and plastic piping systems 2 inches and smaller.
 - 2. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4-inches (100-mm) of insulation.
 - 4. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Exception: The following figure type given in Figure 1 of MSS SP-69 will not be acceptable: Type 16.
 - 2. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 - 3. Steel Clevises (MSS Type 14): For 120 to 450°F (49 to 232°C) piping installations.
 - 4. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450°F (49 to 232°C) piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Exception: The following figure types given in Figure 1 of MSS SP-69 will not be acceptable: 19, 20, 23, 25, 27, 28, 29, 30, and 34.
 - 2. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 pounds (340 kg).
 - b. Medium (MSS Type 32): 1,500 pounds (680 kg).
 - c. Heavy (MSS Type 33): 3,000 pounds (1,360 kg).
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:
continued

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25% to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25% to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25% to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. ASME International (ASME):
 - a. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.04 ACTION SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.05 COORDINATION:

- 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.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS:

- A. Select labels from options listed below.
 - 1. Exception: For labels in Fluoride feed areas, select plastic labels only.
 - a. Metal Labels for Equipment:
 - (1) Material and Thickness: Brass, 0.032-inch (0.8-mm), Stainless steel, 0.025-inch (0.64-mm), Aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - (2) Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - (3) Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT: continued

- greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- (4) Fasteners: Stainless-steel self-tapping screws.
- (5) Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- b. Plastic Labels for Equipment:
 - (1) Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160°F (71°C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Adhesive or as required to mount on equipment.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Exception: For labels in Fluoride feed and storage areas, select plastic labels only
 - 2. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
- C. Equipment Tags: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data: Equipment number (see Schedules on Drawings).
- D. Location: Accessible and visible.

2.02 WARNING SIGNS AND LABELS:

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160°F (71°C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT: continued

2.03 PIPE LABELS:

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.04 VALVE TAGS:

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme approved by Owner.
 - 1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2 by 11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.05 WARNING TAGS:

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches (100 by 178 mm).
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION:

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION:

- A. Piping Color-Coding: Comply with ASME A13.1, unless otherwise indicated.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT: continued

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
- C. Pipe Label Color Schedule:
1. Domestic Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 2. Sanitary Waste Piping:
 - a. Background Color: Gray.
 - b. Letter Color: White.
 3. Fluoride Feed Process Piping
 - a. Background Color: Light Blue with Red Band.
 - b. Letter Color: Black.

3.04 VALVE-TAG INSTALLATION:

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches (38 mm) round or square shape.
 - b. Hot Water: 1-1/2 inches (38 mm) round or square shape.
 - c. Tepid Water: 1-1/2 inches (38 mm) round or square shape.
 2. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Green.
 - c. Tepid Water: Green.
 3. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.
 - c. Tepid Water: White.

3.05 WARNING-TAG INSTALLATION:

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes insulating the following plumbing piping services:
 1. Domestic cold-water piping.
 2. Domestic hot-water piping.
 3. Sanitary waste piping exposed to freezing conditions.

1.03 REFERENCES:

- A. Applicable Standards (latest editions):
 1. ASTM International (ASTM):
 - a. ASTM C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - b. ASTM D1644 - Test Methods for Nonvolatile Content of Varnishes.
 - c. ASTM D1784 - Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - d. ASTM E96/E96M - Test Methods for Water Vapor Transmission of Materials.
 2. Code of Federal Regulations (CFR):
 3. 40 CFR - Protection of Environment, Chapter I - Environmental Protection Agency, Part 59 - "National Volatile Organic Compound Emission Standards for Consumer and Commercial Products," Subpart D - "National Volatile Organic Compound Emission Standards for Architectural Coatings," 2007.

1.04 ACTION SUBMITTALS:

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail insulation application at pipe expansion joints for each type of insulation.
 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 5. Detail application of field-applied jackets.
 6. Detail application at linkages of control devices.

1.05 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For qualified Installer.

1.06 QUALITY ASSURANCE:

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

SECTION 220719 - PLUMBING PIPING INSULATION: continued

- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

- 1.07 DELIVERY, STORAGE, AND HANDLING:
 - A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

- 1.08 COORDINATION:
 - A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT.
 - B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
 - C. Coordinate installation and testing of heat tracing.

- 1.09 SCHEDULING:
 - A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
 - B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

- 2.01 INSULATION MATERIALS:
 - A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
 - B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
 - C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
 - D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
 - E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

SECTION 220719 - PLUMBING PIPING INSULATION: continued

2.02 ADHESIVES:

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
- C. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.

2.03 MASTICS:

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. Armacell LLC; Armaflex 520 Adhesive.
 - 2. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 3. Service Temperature Range: -20 to +180°F (-29 to +82°C).
 - 4. Solids Content: ASTM D1644, 58% by volume and 70% by weight.

2.04 SEALANTS:

- A. Joint Sealants:
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Armacell LLC; Armaflex.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.

SECTION 220719 - PLUMBING PIPING INSULATION: continued

3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: +100 to +300°F (+73 to +149°C).
 5. Color: White or gray.
- B. PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: +40 to +250°F (+40 to +121°C).
 5. Color: White.
- 2.05 FIELD-APPLIED JACKETS:
- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.
- 2.06 TAPES:
- A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500%.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

SECTION 220719 - PLUMBING PIPING INSULATION: continued

1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 PREPARATION:
- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
 1. Ensure adhesive will adhere to any primers used to protect pipes.
- 3.03 GENERAL INSTALLATION REQUIREMENTS:
- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
 - B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
 - C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
 - D. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
 - E. Keep insulation materials dry during application and finishing.
 - F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
 - G. Install insulation with least number of joints practical in accordance with manufacturer's recommendations.
 - H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 3. Cover inserts with jacket material matching adjacent pipe insulation.
 - I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
 - J. Cut insulation in a manner to avoid compressing insulation more than 75% of its nominal thickness.
 - K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
 - L. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere and seal patches similar to butt joints.
 - M. For above-ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.
- 3.04 PENETRATIONS:
- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.

SECTION 220719 - PLUMBING PIPING INSULATION: continued

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
 - B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
 - C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
 - D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
 - E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in DIVISION 07 for firestopping and fire-resistive joint sealers.
 - F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
- 3.05 GENERAL PIPE INSULATION INSTALLATION:
- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
 - B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

SECTION 220719 - PLUMBING PIPING INSULATION: continued

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION:

- A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.

SECTION 220719 - PLUMBING PIPING INSULATION: continued

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 FIELD-APPLIED JACKET INSTALLATION:

- A. Where PVC jackets are indicated, install with 1 inch (25 mm) overlap at longitudinal seams and end joints. Seal with manufacturers recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.08 FIELD QUALITY CONTROL:

- A. Tests and Inspections:
 1. Provide photographs during and after insulation to allow inspection of insulation at pipe, fittings, strainers, and valves. Provide pictures of three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if inspection reveals noncompliance with requirements.

3.09 PIPING INSULATION SCHEDULE, GENERAL:

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.

3.10 INDOOR PIPING INSULATION SCHEDULE:

- A. Domestic Cold Water:
 1. NPS 1 (DN 25) and Smaller: Insulation shall be:
 - a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
 2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
- B. Domestic Hot Water:
 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be:
 - a. Flexible Elastomeric: 1 inch (19 mm) thick.
 2. NPS 1-1/2 (DN 40)and Larger: Insulation shall be:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
- C. Domestic Tepid Water:
 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be:
 - a. Flexible Elastomeric: 1 inch (19 mm) thick.
 2. NPS 1-1/2 (DN 40)and Larger: Insulation shall be:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE:

- A. Domestic Water Piping:
 1. All Pipe Sizes: Insulation shall be:

SECTION 220719 - PLUMBING PIPING INSULATION: continued

- a. Flexible Elastomeric: 2 inches (50 mm) thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE:

- A. Install jacket over insulation material.
- B. Piping, Exposed:
 - 1. PVC: 20 mils (0.5 mm).

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE:

- A. Install jacket over insulation material.
- B. Piping, Exposed:
 - 1. PVC: 20 mils (0.5 mm) thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Water Works Association (AWWA):
 - a. AWWA C651 - Disinfecting Water Mains.
 - b. AWWA C652 - Disinfection of Water-Storage Facilities.
 - 2. American Welding Society (AWS):
 - a. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.
 - 3. ASME International (ASME):
 - a. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
 - b. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - c. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - d. ASME B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500.
 - e. ASME B31.9 - Building Services Piping.
 - 4. ASTM International (ASTM):
 - a. ASTM B32 - Specification for Solder Metal.
 - b. ASTM B75 - Specification for Seamless Copper Tube.
 - c. ASTM B88 - Specification for Seamless Copper Water Tube.
 - d. ASTM B584 - Specification for Copper Alloy Sand Castings for General Applications.
 - e. ASTM B813 - Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
 - f. ASTM B828 - Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - g. ASTM F402 - Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and fittings.
 - h. ASTM F437 - Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
 - i. ASTM F438 - Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
 - j. ASTM F439 - Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
 - k. ASTM F441/F441M - Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
 - l. ASTM F493 - Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
 - 5. Copper Development Association:

SECTION 221116 - DOMESTIC WATER PIPING: continued

- a. Copper Tube Handbook, 2006.
 - 6. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - a. MSS SP-69 - Pipe Hangers and Supports - Selection and Application (ANSI).
 - b. MSS SP-123 - Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube.
 - 7. NSF International (NSF):
 - a. NSF 14-2008 - Plastics Piping System Components and Related Materials (ANSI).
 - b. NSF 61-2008 - Drinking Water System Components - Health Effects (ANSI).
- 1.04 INFORMATIONAL SUBMITTALS:
- A. System purging and disinfecting activities report.
 - B. Field quality-control reports.
- 1.05 FIELD CONDITIONS:
- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

- 2.01 PIPING MATERIALS:
- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
 - B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."
- 2.02 COPPER TUBE AND FITTINGS:
- A. Hard Copper Tube: ASTM B88, Type L (ASTM B88M, Type B and ASTM B88, Type M (ASTM B88M, Type C) water tube, drawn temper.
 - B. Soft Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) and ASTM B88, Type L (ASTM B88M, Type B) water tube, annealed temper.
 - C. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- 2.03 CPVC PIPING:
- A. CPVC Pipe: ASTM F441/F441M, Schedule 80.
 - 1. CPVC Socket Fittings: ASTM F439 for Schedule 80.
 - 2. CPVC Threaded Fittings: ASTM F437, Schedule 80.
 - B. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.
 - C. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.
- 2.04 PIPING JOINING MATERIALS:
- A. Solder Filler Metals: ASTM B32, lead-free alloys.

SECTION 221116 - DOMESTIC WATER PIPING: continued

- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
- C. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

2.05 ENCASEMENT FOR PIPING:

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Tube.
- C. Color: Black.

2.06 SPECIALTY VALVES

- A. Comply with requirements in Section 220523 – General Duty Valves for Plumbing Piping.
- B. CPVC Union Ball Valves
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Asahi/America, Inc.
 - b. Fischer, George Inc.
 - c. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - d. NIBCO INC.
 - e. Sloane, George Fischer, Inc.
 - f. Engineer-Approved Equal.
 - 2. Description:
 - a. Standard MSS SP-122.
 - b. Pressure Rating: 125 psig (80 kPa) 73°F (23°C).
 - c. Body Material: CPVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket.
 - g. Ball: CPVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.
- C. CPVC Ball Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Asahi/America, Inc.
 - b. Fischer, George Inc.
 - c. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - d. NIBCO INC.
 - e. Sloane, George Fischer, Inc.
 - f. Engineer-Approved Equal.
 - 2. Description:
 - a. Pressure Rating: 125 psig (80 kPa) 73°F (23°C).
 - b. Body Material: CPVC.
 - c. Body Design: Union-type ball check.
 - d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket.
 - f. Ball: CPVC.
 - g. Seals: PTFE or FKM-rubber O-rings.

SECTION 221116 - DOMESTIC WATER PIPING: continued

D. CPVC Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloane, George Fischer, Inc.
 - b. Spears Manufacturing Company.
2. Description:
 - a. Pressure Rating: 125 psig (80 kPa) 73°F (23°C).
 - b. Body Material: CPVC.
 - c. Body Design: Nonrising stem.
 - d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket.
 - f. Gate and Stem: Plastic.
 - g. Seals: EPDM rubber.
 - h. Handle: Wheel.

2.07 TRANSITION FITTINGS:

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
2. Description:
 - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO, Inc.
 - c. Spears Manufacturing Company.

SECTION 221116 - DOMESTIC WATER PIPING: continued

2. Description:
 - a. CPVC four-part union.
 - b. Brass or stainless-steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

PART 3 - EXECUTION

3.01 EARTHWORK:

- A. Comply with requirements in DIVISION 31 for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION:

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated, unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES.
- F. Install domestic water piping level without pitch and plumb.
- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below, unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermometers on outlet piping from each water heater.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING.
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING.

SECTION 221116 - DOMESTIC WATER PIPING: continued

3.03 JOINT CONSTRUCTION:

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- E. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- F. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 TRANSITION FITTING INSTALLATION:

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.05 HANGER AND SUPPORT INSTALLATION:

- A. Comply with requirements for pipe hanger, support products, and installation in SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

SECTION 221116 - DOMESTIC WATER PIPING: continued

- 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).
- F. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
- G. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS:

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.07 IDENTIFICATION:

- A. Identify system components. Comply with requirements for identification materials and installation in SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT.

3.08 FIELD QUALITY CONTROL:

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - (1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - (2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

SECTION 221116 - DOMESTIC WATER PIPING: continued

- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
 - B. Domestic water piping will be considered defective if it does not pass tests and inspections.
 - C. Prepare test and inspection reports.
- 3.09 ADJUSTING:
- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 7. Check plumbing specialties and verify proper settings, adjustments, and operation.
- 3.10 CLEANING:
- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - (1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - (2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

SECTION 221116 - DOMESTIC WATER PIPING: continued

- d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
 - B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
 - C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- 3.11 PIPING SCHEDULE:
- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 - B. Flanges and unions may be used for aboveground piping joints, unless otherwise indicated.
 - C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
 - D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller, shall be one of the following unless otherwise noted:
 - 1. Soft copper tube, ASTM B88, Type K (ASTM B88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
 - 2. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
 - E. Buried-service piping, NPS 2 to NPS 6 (DN 100 to DN 200) shall be:
 - 1. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
 - F. Aboveground domestic water piping, NPS 3 (DN 50) and smaller, shall be one of the following:
 - 1. Electrical/Mechanical Equipment Room:
 - a. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B) cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
 - 2. Fluoride Feed Room:
 - a. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
- 3.12 VALVE SCHEDULE:
- A. Drawings indicate valve types to be used.
 - 1. In Fluoride Rooms, provide CPVC valves.
 - B. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - C. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. This Section includes:
 - 1. Backflow preventers.
 - 2. Water pressure-reducing valves.
 - 3. Strainers.
 - 4. Hose bibbs.
 - 5. Water-hammer arresters.
 - 6. Specialty valves.
 - 7. Dial-type pressure gages.
- 1.03 RELATED REQUIREMENTS:
- A. Section 221116 - Domestic Water Piping
 - B. Section 224500 - Emergency Plumbing Fixtures for water tempering equipment.
- 1.04 REFERENCE STANDARDS:
- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - B. American Society of Sanitary Engineering (ASSE):
 - 1. ASSE 1001 - Performance Requirements for Atmospheric Type Vacuum Breakers.
 - 2. ASSE 1003 - Performance Requirements for Water Pressure-Reducing Valves (ANSI).
 - 3. ASSE 1010 - Performance Requirements for Water-Hammer Arresters (ANSI).
 - 4. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers (ANSI).
 - 5. ASSE 1013 - Performance Requirements for Reduced-Pressure-Principle Backflow Preventers and Reduced-Pressure Fire-Protection Principle Backflow Preventers (ANSI).
 - 6. ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems.
 - 7. ASSE 1020 - Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI).
 - 8. ASSE 1022 - Performance Requirements for Backflow Preventer for Beverage Dispensing Equipment (ANSI).
 - C. ASME International (ASME):
 - 1. ASME A112.1.2 - Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors).
 - 2. ASME A112.18.1 - Plumbing Supply Fittings.
 - 3. ASME A112.21.3M - Hydrants for Utility and Maintenance Use.
 - 4. ASME B1.20.7 - Hose Coupling Screw Threads, Inch.
 - 5. ASME B40.100 - Pressure Gauges and Gauge Attachments.
 - D. ASTM International (ASTM):
 - 1. ASTM B62 - Specification for Composition Bronze or Ounce Metal Castings.
 - 2. ASTM B88 - Specification for Seamless Copper Water Tube.
 - 3. ASTM B88M - Specification for Seamless Copper Water Tube.
 - E. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - 1. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES: continued

2. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
 - F. NFPA:
 1. NFPA 70 - National Electrical Code.
 - G. NSF International (NSF):
 1. NSF 61 - Drinking Water System Components - Health Effects; Sections 1 through 9 (ANSI).
 2. NSF 372 – Drinking Water System Components – Lead Content
 - H. Plumbing & Drainage Institute (PDI):
 1. PDI-WH 201 - Water-Hammer Arresters.
- 1.05 SUBMITTALS:
- A. Product Data: For each type of product.
 - B. Field quality-control reports.
 - C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

- 2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES:
- A. Potable-water piping and components shall comply with NSF 61 and 372.
- 2.02 PERFORMANCE REQUIREMENTS:
- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.
 - B. Hose-Connection Vacuum Breakers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - d. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - e. Zurn Industries, LLC; Plumbing Products Group.
 2. Standard: ASSE 1011.
 3. Body: Bronze, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.
- 2.03 BACKFLOW PREVENTERS:
- A. Reduced-Pressure-Principle Backflow Preventers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
 2. Body:

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES: continued

- a. NPS 2 (DN 50) and Smaller: Bronze.
- b. NPS 2-1/2 (DN 65) and Larger: Cast iron, steel or stainless steel.
- c. Cast iron and steel body backflow preventers shall be provided with interior lining complying with AWWA C550 or that is FDA approved.
3. Standards: ASSE 1013 or AWWA C511.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
8. Capacities and Characteristics: See Drawings.

2.04 WATER PRESSURE-REDUCING VALVES:

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
5. End Connections: Threaded for NPS 2 (DN 50) and smaller, flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
6. Capacities and Characteristics: See Drawings.

2.05 STRAINERS FOR DOMESTIC WATER PIPING:

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
2. Body:
 - a. NPS 2 (DN 50) and Smaller: Bronze.
 - b. NPS 2-1/2 (DN 65) and Larger: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.033 inches (0.84 mm).
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inches (1.14 mm).
6. Drain: Pipe plug or factory-installed, hose-end drain valve as indicated.

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES: continued

2.06 HOSE BIBBS:

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: PVC.
3. Seat: Non-metallic.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Operation for Equipment Rooms: Wheel handle.
9. Operation for Service Areas: Wheel handle.

2.07 WATER-HAMMER ARRESTERS:

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. Precision Plumbing Products, Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Drainage Products.
 - g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.08 SPECIALTY VALVES:

- A. Comply with requirements for general-duty metal valves in DIVISION 22, Section "General-Duty Valves for Plumbing Piping."

2.09 DIRECT-MOUNTED, PLASTIC-CASE, DIAL-TYPE PRESSURE GAUGES:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft, Inc.
 - b. Terrice, H. O. Co.
 - c. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed plastic 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type, unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Plastic.
10. Accuracy: Grade A, $\pm 1\%$ of middle half of scale range.

B.

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES: continued

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 2. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves.
- C. Install water-hammer arresters in water piping according to PDI-WH 201.

3.02 GAUGE APPLICATIONS

- A. Install dry-case-type pressure gauges for discharge of each pressure-reducing valve.

3.03 CONNECTIONS:

- A. Comply with requirements for piping specified in other DIVISION 22 sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.04 LABELING AND IDENTIFYING:

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Water pressure-reducing valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 - Identification for Plumbing Piping and Equipment.

3.05 FIELD QUALITY CONTROL:

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker and backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.06 ADJUSTING:

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
 - a. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.
 - 2. American Society of Sanitary Engineering (ASSE):
 - a. ASTM D2321 - Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - b. ASTM D2564 - Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - c. ASTM D2665 - Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - d. ASTM D2855 - Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - e. ASTM D3311 - Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns.
 - f. ASTM D5926 - Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Plastic Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems.
 - g. ASTM F402 - Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
 - h. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 3. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
 - a. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.
 - 4. NSF International (NSF):
 - a. NSF/ANSI 14 - Plastics Piping System Components and Related Materials.

1.04 PERFORMANCE REQUIREMENTS:

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.05 ACTION SUBMITTALS:

- A. Product Data: For pipe, tube, fittings and couplings.

1.06 INFORMATIONAL SUBMITTALS:

- A. Field quality-control reports.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

1.07 QUALITY ASSURANCE:

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.08 PROJECT CONDITIONS:

- A. Interruption of Existing Waste Service: Do not interrupt service to facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than 2 days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS:

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 PVC PIPE AND FITTINGS:

- A. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F656.
- D. Solvent Cement: ASTM D2564.

2.03 SPECIALTY PIPE FITTINGS:

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers; Subject to compliance with requirements, provide products by one of the following:
 - (1) Dallas Specialty & Mfg. Co.
 - (2) Fernco, Inc.
 - (3) Mission Rubber Company; a division of MCP Industries, Inc.
 - (4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - (1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - (2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

- (3) For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Cascade Waterworks Mfg. Co.
 - (2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Cascade Waterworks Mfg. Co.
 - (2) Dresser, Inc.
 - (3) EBAA Iron, Inc.
 - (4) JCM Industries, Inc.
 - (5) Romac Industries, Inc.
 - (6) Smith-Blair, Inc.; a Sensus company.
 - (7) The Ford Meter Box Company, Inc.
 - (8) Viking Johnson.
 - b. Standard: AWWA C219.
 - c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: Manufacturer's standard.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.01 EARTH MOVING:

- A. Comply with requirements for excavating, trenching, and backfilling specified in DIVISION 31.

3.02 PIPING INSTALLATION:

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

- H. Install fittings for changes in direction and branch connections.
 - I. Install piping to allow application of insulation.
 - J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 - K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - L. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2% downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1% downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2% downward in direction of flow.
 - 3. Vent Piping: 1% down toward vertical fixture vent or toward vent stack.
 - M. Install aboveground PVC piping according to ASTM D2665.
 - N. Install underground PVC piping according to ASTM D2321.
 - O. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - P. Plumbing Specialties:
 - 1. Install cleanouts at grade. Comply with requirements for cleanouts specified in SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES.
 - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES.
 - Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - R. Install sleeves for piping penetrations of walls, ceilings, and floors.
- 3.03 JOINT CONSTRUCTION:
- A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D2855 and ASTM D2665 Appendixes.
- 3.04 SPECIALTY PIPE FITTING INSTALLATION:
- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

3.05 HANGER AND SUPPORT INSTALLATION:

- A. Comply with requirements for pipe hanger and support devices and installation specified in SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT.
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- D. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
- E. Install supports for vertical PVC piping every 48 inches (1200 mm).
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS:

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to existing sewerage piping as indicated on drawings. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Comply with requirements for cleanouts and drains specified in SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES.
 - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.07 FIELD QUALITY CONTROL:

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.08 CLEANING AND PROTECTION:

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.09 PIPING SCHEDULE:

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Roof flashing assemblies.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. ASME International (ASME):
 - a. ASME A112.1.2 - Air Gaps in Plumbing Systems.
 - b. ASME A112.6.3 - Floor and Trench Drains.
 - c. ASME A112.36.2M - Cleanouts.
 - 2. ASTM International (ASTM):
 - a. ASTM A48/A48M - Specification for Gray Iron Castings.
 - b. ASTM A74 - Specification for Cast Iron Soil Pipe and Fittings.
 - c. ASTM B32 - Specification for Solder Metal.
 - d. ASTM B749 - Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.

1.04 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE:

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.06 COORDINATION:

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.01 CLEANOUTS:

- A. PVC Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Sioux Chief Manufacturing Company, Inc.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

- c. Watts Drainage Products, Inc.
- d. Zurn Plumbing Products Group; Light Commercial Operation.
- e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body: ABS or PVC
6. Clamping Device: Not required.
7. Outlet Connection: Spigot.
8. Closure: Cast-iron or plastic plug.
9. Adjustable Housing Material: Plastic with threads.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.02 FLOOR DRAINS:

A. Plastic Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas, LLC.
 - b. IPS Corporation.
 - c. Josam Company; Josam Div.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.6.3.
3. Material: ABS or PVC.
4. Seepage Flange: Required.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Sediment Bucket: Not required.
8. Top or Strainer Material: Plastic.
9. Top Shape: Round.
10. Dimensions of Top or Strainer: 6 inch.
11. Trap Material: Plastic drainage piping.
12. Trap Pattern: Standard P-trap.

2.03 ROOF FLASHING ASSEMBLIES:

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 4.0 lb/sq. ft. (20-kg/sq. m), 0.0625 inch (1.6 mm) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 1. Open-Top Vent Cap: Without cap.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES:

- A. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.05 FLASHING MATERIALS:

- A. Lead Sheet: ASTM B749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft. (20 kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 2. Vent Pipe Flashing: 3.0 lb/sq. ft. (15 kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 3. Burning: 6 lb/sq. ft. (30 kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping, unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1% slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1% slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1% slope, but not greater than 1-inch (25 mm) total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

3.02 CONNECTIONS:

- A. Piping installation requirements are specified in other DIVISION 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION:

- A. Fabricate flashing from single piece, unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of lead sheets 6.0 lb/sq. ft. (30 kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0 lb/sq. ft. (20 kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to DIVISION 07.

3.04 PROTECTION:

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Commercial, light-duty, storage, electric, domestic-water heaters.
 - 2. Domestic-water heater accessories.
 - 3. Bimetallic-actuated thermometers.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American National Standards Institute/CSA International (ANSI/CSA):
 - a. ANSI/CSA LC 3 - Appliance Stands and Drain Pans.
 - b. ANSI Z21.22/CSA 4.4-M99 - Relief Valves for Hot Water Supply Systems
 - 2. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
 - a. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ASHRAE 90.2 - Energy Efficient Design of Low-Rise Residential Buildings (ANSI).
 - 4. American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA):
 - a. ASHRAE/IESNA 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings (ANSI).
 - 5. American Society of Sanitary Engineering (ASSE):
 - a. ASSE 1003 - Water Pressure Reducing Valves.
 - b. ASSE 1005 - Water Heater Drain Valves.
 - c. ASSE 1010 - Water Hammer Arresters.
 - 6. ASME International (ASME):
 - a. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
 - b. ASME B1.20.7 - Hose Coupling Screw Threads, Inch.
 - c. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
 - d. ASME B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500, and 2500.
 - e. 2007 ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
 - 7. NFPA:
 - a. NFPA 70 - National Electrical Code.
 - 8. NSF International (NSF):
 - a. NSF 5 - Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment.
 - b. NSF 61 - Drinking Water System Components - Health Effects.
 - 9. Plumbing & Drainage Institute (PDI):
 - a. PDI-WH 201 - Water Hammer Arresters.
 - 10. Underwriters Laboratories, Inc. (UL):
 - a. UL 174 - Household Electric Storage Tank Water Heaters.
 - b. UL 499 - Electric Heating Appliances.
 - c. UL 1279 - Solar Collectors.

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS: continued

- d. UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.
- 11. ASME International (ASME):
 - a. ASME B40.200 - Thermometers, Direct Reading and Remote Reading.
- 1.04 ACTION SUBMITTALS:
 - A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- 1.05 INFORMATIONAL SUBMITTALS:
 - A. Source quality-control reports.
 - B. Field quality-control reports.
 - C. Warranty: Sample of special warranty.
- 1.06 CLOSEOUT SUBMITTALS:
 - A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.
- 1.07 QUALITY ASSURANCE:
 - 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. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."
- 1.08 COORDINATION:
 - A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- 1.09 WARRANTY:
 - 1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - (1) Storage Tank: 3 years.
 - (2) Controls and Other Components: 1 year.

PART 2 - PRODUCTS

- 2.01 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS:
 - A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Water Heaters.
 - b. Bradford White Corporation.
 - c. Electric Heater Company (The).
 - d. GSW Water Heating.
 - e. Heat Transfer Products, Inc.
 - f. Lochinvar Corporation.
 - g. Rheem Manufacturing Company.
 - h. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS: continued

- i. State Industries.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required, unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
- B. Capacity and Characteristics:
 1. Capacity: 65 gallons.
 2. Recovery: 49 gph at 100°F temperature rise.
 3. Temperature Setting: 140°F.
 4. Power Demand: 12 kilowatts.
 5. Heating Elements:
 - a. Number of Elements: 2.
 - b. Kilowatts Each Element: 6 kilowatts.
 6. Electrical Characteristics:
 - a. Volts: 208.
 - b. Phases: Single.
 - c. Hertz: 60.

2.02 DOMESTIC-WATER HEATER ACCESSORIES:

- A. Expansion Tanks.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Flexcon Industries.
 - c. Honeywell International, Inc.
 - d. Pentair Pump Group (The); Myers.
 - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - f. State Industries.
 - g. Taco, Inc.
 2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS: continued

3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
 - a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: 2.66 gallons minimum.
 - c. Air Precharge Pressure: 40 psi.
- B. Drain Pans: Aluminum with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.

2.03 LIQUID-IN-GLASS THERMOMETERS:

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Ince.
 2. Standard: ASME B40.200.
 3. Case: Cast aluminum; 7-inch (178-mm) nominal size.
 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in °F and °C.
 6. Window: Glass.
 7. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 8. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
 9. Accuracy: ±1% of scale range or one scale division, to a maximum of 1.5% of scale range.

2.04 THERMOWELLS:

- A. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Manufacturer: Same as manufacturer of thermometer being used.
 4. Type: Stepped shank, unless straight or tapered shank is indicated.
 5. Bore: Diameter required to match thermometer bulb or stem.
 6. Insertion Length: Length required to match thermometer bulb or stem.
 7. Lagging Extension: Include on thermowells for insulated piping and tubing.
 8. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS: continued

- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.05 SOURCE QUALITY CONTROL:

- A. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in DIVISION 01 for retesting and reinspecting requirements and DIVISION 01 for requirements for correcting the Work.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

- A. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on floor or on water-heater stand on floor.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING.
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES.
- E. Install thermometers on outlet piping of electric, domestic-water heaters.
- F. Comply with requirements for pressure-reducing valves and water hammer arresters specified in SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES.
- G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill electric, domestic-water heaters with water.
- I. Charge domestic-water compression tanks with air.

3.02 INSTALLATION:

- A. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS: continued

- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

3.03 CONNECTIONS:

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.04 FIELD QUALITY CONTROL:

- A. Perform tests and inspections.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in DIVISION 01 for retesting and reinspecting requirements and DIVISION 01 for requirements for correcting the Work.
- C. Prepare test and inspection reports.

END OF SECTION 223300

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Combination units.
 - 2. Supplemental equipment.
 - 3. Water-tempering equipment.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American National Standards Institute (ANSI):
 - a. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
 - 2. American Society of Mechanical Engineers/Canadian Standards Association (ASME/CSA):
 - a. ASME A112.18.2/CSA B125.2 - Plumbing Waste Fittings.
 - 3. Federal Government:
 - a. Public Law 90-480 - Architectural Barriers Act.
 - b. Public Law 101-336 - Americans with Disabilities Act.
 - 4. International Code Council/American National Standards Institute (ICC/ANSI):
 - a. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 5. NFPA:
 - a. NFPA 70 - National Electrical Code.
 - 6. NSF International (NSF):
 - a. NSF 61 - Drinking Water System Components - Health Effects.

1.04 DEFINITIONS:

- A. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- B. Tepid: Moderately warm.

1.05 ACTION SUBMITTALS:

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.06 INFORMATIONAL SUBMITTALS:

- A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- B. Field quality-control test reports.

1.07 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

SECTION 224500 - EMERGENCY PLUMBING FIXTURES: continued

1.08 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.09 QUALITY ASSURANCE:

- 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. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.01 COMBINATION UNITS:

- A. Standard, Plumbed Emergency Shower with Eyewash Combination Units, P101, P201:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Safety; a division of Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Sellstrom Manufacturing Company.
 - g. Speakman Company.
 - h. WaterSaver Faucet Co.
 - 2. Piping:
 - a. Material: PVC.
 - b. Unit Supply: NPS 1-1/4 minimum.
 - c. Unit Drain: Outlet at back or side near bottom.
 - 3. Shower:
 - a. Capacity: Not less than 20 gpm for at least 15 minutes.
 - b. Supply Piping: Minimum NPS 1 (DN 25) with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Pull rod.
 - d. Shower Head: 8-inch minimum diameter, plastic.
 - e. Mounting: Pedestal.
 - 4. Eyewash Unit:
 - a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - b. Supply Piping: Minimum NPS 1/2 (DN 15) with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Spray-Head Assembly: Two receptor-mounted spray heads.
 - e. Receptor: Plastic bowl.
 - f. Mounting: Attached shower pedestal.
- B. Freeze-Protected, Plumbed Emergency Shower with Eyewash Combination Units, D102, P102, D202, P202:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Haws 8300FP or a comparable product by one of the following:
 - a. B-L-S Industries, Inc.

SECTION 224500 - EMERGENCY PLUMBING FIXTURES: continued

- b. Bradley Corporation.
- c. Encon Safety Products.
- d. Guardian Equipment Co.
- e. Haws Corporation.
- f. Speakman Company.
- 2. Description: Plumbed, freeze-protected, freestanding, with emergency shower and eye wash equipment.
- 3. Piping: Galvanized steel.
 - a. Unit Supply: NPS 1-1/4 (DN 32) minimum from bottom.
 - b. Shower Supply: NPS 1-1/4 (DN 32) with flow regulator and stay-open control valve.
 - c. Eye/Face Wash Supply: NPS 3/4 (DN 20) with flow regulator and stay-open control valve.
- 4. Shower:
 - a. Capacity: Not less than 20 gpm for at least 15 minutes.
 - b. Control-Valve Actuator: Paddle.
- 5. Eyewash Unit:
 - a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
 - b. Control-Valve Actuator: Paddle.

2.02 WATER-TEMPERING EQUIPMENT:

- A. Hot- and Cold-Water, Mixing Valve, MV1:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Bradley S19-2200 or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Bradley Corporation.
 - c. Encon Safety Products.
 - d. Haws Corporation.
 - e. Lawler Manufacturing Co., Inc.
 - f. Leonard Valve Company.
 - g. Powers, a Watts Industris Co.
 - h. Speakman Company.
 - i. Therm-Omega-Tech, Inc.
 - j. Western Emergency Equipment.
 - 2. Description: Factory-fabricated equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide 60°F tepid, potable water at emergency plumbing fixtures, to maintain temperature throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
 - b. Supply Connections: For hot and cold water.

2.03 SOURCE QUALITY CONTROL:

- A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

SECTION 224500 - EMERGENCY PLUMBING FIXTURES: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EMERGENCY PLUMBING FIXTURE INSTALLATION:

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING and SECTION 221116 - DOMESTIC WATER PIPING.
- E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in SECTION 221116 - DOMESTIC WATER PIPING.
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in SECTION 223300 – ELECTRIC, DOMESTIC-WATER HEATERS.
- G. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in DIVISION 22 Section "Sanitary Waste and Vent Piping."

3.03 CONNECTIONS:

- A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in DIVISION 22 Section "Domestic Water Piping."
- B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in DIVISION 22 Section "Domestic Water Piping."
- C. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.
- D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.04 FIELD QUALITY CONTROL:

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

SECTION 224500 - EMERGENCY PLUMBING FIXTURES: continued

- C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.05 ADJUSTING:

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION 224500

DIVISION 23 - HVAC

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 REFERENCES:

- A. Applicable Standards (latest edition):
 - 1. The Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 841-2001 - Standard for Petroleum and Chemical Industry - Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp).
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. NEMA MG 1 - Motors and Generators.

1.04 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.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS:

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS:

- A. Duty: Continuous duty at ambient temperature of 40° and at altitude of 3300 feet (1000 m) above sea level.
- B. 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.

2.03 POLYPHASE MOTORS:

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT: continued

- C. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- E. Temperature Rise: Match insulation rating.
- F. Insulation: Class F.
- G. Code Letter Designation:
 - 1. Motors Smaller than 5 HP: Manufacturer's standard starting characteristic.

2.04 SINGLE-PHASE MOTORS:

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. 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 shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 230513

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.02 REFERENCES:

- A. Applicable Standards (latest edition):
 - 1. Air Movement and Control Association International Inc. (AMCA):
 - a. 201 - Fans and Systems.
 - 2. American National Standards Institute (ANSI):
 - a. S1.4 - Specification for Sound Level Meters.
 - b. S1.11 - Specification for Octave Band and Fraction Octave Band Analog and Digital Filters.
 - c. S1.13 - Methods for the Measurement of Sound Pressure Levels.
 - d. S1.40 - Specification for Acoustical Calibrators.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 62.1 - Ventilation for Acceptable Indoor Air Quality (ANSI).
 - b. 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 4. Associated Air Balance Council (AABC):
 - a. National Standards for Total System Balance.
 - 5. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 6. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. HVAC Systems - Duct Design.
 - b. HVAC Systems - Testing, Adjusting, and Balancing.

1.03 DEFINITIONS:

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.
- F. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- G. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- H. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- I. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin that is normally dissipated.
- J. NC: Noise criteria.
- K. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- L. RC: Room criteria.
- M. Report Forms: Test data sheets for recording test data in logical order.
- N. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- O. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- P. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- Q. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- R. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- S. Test: A procedure to determine quantitative performance of systems or equipment.
- T. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 SUBMITTALS:

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. 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.

1.05 QUALITY ASSURANCE:

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.
- B. TAB Contractor shall have a minimum of two years experience in the TAB industry and shall demonstrate that they have performed work on projects of similar nature.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.06 PROJECT CONDITIONS:

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- 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.

1.07 COORDINATION:

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION

3.01 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 systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine Equipment performance data including fan and pump 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.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC Equipment when installed under conditions different from the conditions used to rate Equipment

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design."

Compare results with the design data and installed conditions.

- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC Equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- J. Examine operating safety interlocks and controls on HVAC Equipment.
- K. 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.
- L. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 5. Sensors are located to sense only the intended conditions.
 - 6. Sequence of operation for control modes in according to the Contract Documents.
 - 7. Controller set points are set at indicated values.
 - 8. Interlocked systems are operating.

3.02 PREPARATION:

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

4. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING:

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance," NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing"] and in this Section.
 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2, "Air Balancing."
- B. Mark Equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS:

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Check airflow patterns from the outdoor-air louvers and dampers.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.
- G. Check for airflow blockages.
- H. Check for proper sealing of air-handling-unit components.

3.05 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 sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible.
3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 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. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.07 TOLERANCES:

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10%
 2. Air Outlets and Inlets: 0 to plus 10%.

3.08 REPORTING:

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.09 FINAL REPORT:

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- 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.
- 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 contractor.
 - 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. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans performance forms including the following:
 - a. Settings for outdoor- and exhaust-air dampers.
 - b. Cooling coil, wet- and dry-bulb conditions.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- c. Face and bypass damper settings at coils.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Inlet vane settings for variable-air-volume systems.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
- 1. Quantities of outdoor and exhaust airflows.
 - 2. Duct, outlet, and inlet sizes.
 - 3. Balancing stations.
 - 4. Position of balancing devices.
- 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 (mm), and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- d. Discharge static pressure in inches wg (Pa).
- e. Suction static pressure in inches wg (Pa).
- F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in °F (°C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated air flow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual air flow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).

3.10 INSPECTIONS:

- A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 - 2. Check the following for each system:
 - a. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - b. Verify that balancing devices are marked with final balance position.
 - c. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
 - 1. After testing and balancing are complete, operate system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- C. Prepare test and inspection reports.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

3.11 ADDITIONAL TESTS:

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls, electronic actuators and dampers.

1.03 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. Air Movement and Control Association International, Inc. (AMCA):
 - a. AMCA 500D - Methods of Testing Dampers for Rating.
 - 2. NFPA:
 - a. NFPA 70 - National Electrical Code.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 2605-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

1.04 SYSTEM DESCRIPTION:

- A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

1.05 SEQUENCE OF OPERATION:

- A. As specified on drawings.

1.06 ACTION SUBMITTALS:

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.

1.07 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in DIVISION 01, include the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

1.08 QUALITY ASSURANCE:

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.09 COORDINATION:

- A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

PART 2 - PRODUCTS

2.01 THERMOSTATS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Honeywell International Inc.; Home & Building Control.
 2. Johnson Controls, Inc.; Controls Group.
- B. Adjustable Set Point, Wall-Mounted, Corrosion Resistant Thermostats. Line voltage, industrial grade thermostats with a range of 35°F to 100°F, a nonadjustable differential of 2.0°F, and a 1 HP rated SPDT switch.

2.02 ACTUATORS:

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 2. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. by lbf (16.9 N by m) and breakaway torque of 300 in. by lbf (33.9 N by m).
 3. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. by lbf (16.9 N by m).
 4. Limit switches: Required for full open position.
 5. Dampers shall power open and spring close.
 6. Damper motors shall be mounted out of the airstream.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Belimo Aircontrols (USA), Inc.
 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq.ft. (86.8 kg-cm/sq. m) of damper.
 3. Coupling: V-bolk and V-shaped, toothed crade.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements: 24 Vac, power closed, spring open.
7. Proportional Signal: 2 to 10Vdc or 4 to 20 mA, and 2 to 10Vdc position feedback signal.
8. Temperature Rating: 40 to 104°F (5 to 40°C).
9. Run Time: 15 seconds open, 15 seconds closed.
10. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140°F (10 to 60°C) unless located in return-air plenums.

2.03 DAMPERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Manufacturers:
 - a. Ruskin.
 - b. Greenheck.
 - c. Arrow United Industries; a division of Mestek, Inc.
- B. Frames:
 1. 4" x 1" extruded aluminum hat channel with 0.125 inch thickness (minimum).
 2. Mounting flanges on both sides of the frame.
 3. Linkage shall be concealed in the frame.
- C. Blades:
 1. 4 inch wide, heavy gage extruded aluminum, airfoil shape.
 2. Integral structural reinforcing tube running the full length of each blade.
 3. Parallel blades for two-position applications.
 4. Class 1A damper. Leakage shall not exceed 3 cfm per square foot of damper area at 1-inch water gauge pressure differential.
 5. Blades shall have edge seals.
- D. Bearings:
 1. Molded synthetic bearings.
- E. Accessories:
 1. Provide interconnecting hardware when two or more damper modules are required.
 2. Provide extended shafts or axles for damper operators.
 3. Linkages and jackshafts shall be provided as required.
- F. General:
 1. Dampers furnished shall be fabricated by a manufacturer specializing in the fabrication of dampers.
 2. Dampers shall be gang-operated aluminum blades with synthetic bearings.
 3. Provide complete with aluminum formed channel frame, side stops, end stops, and structural shapes required to support the dampers.
 4. Damper hardware: Ventlok with insulation extension, where required.
 5. Size dampers as required to fit openings and as indicated. Coordinate with equipment furnished.
 6. Divide into sections not over 50 inches wide and 96 inches long.
 7. Damper motor control shaft shall extend the entire length of damper blade on dampers over 36 inches in height.
 8. Space tie bars 24 inches or less apart on control dampers over 36 inches in height.
 9. Maximum blade length: 48 inches.
 10. Damper blade shall be welded, pinned, splined, or bolted to the shaft. Set screws are not acceptable.
 11. Coordinate operating shaft and linkage with automatic control damper motors.

12. Operating temperature range of -40°F to 200°F.
- G. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70% PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 1. Color and Gloss: As selected by Architect/Engineer from manufacturer's full range.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Verify location of thermostats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above the floor.
- B. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

3.02 ELECTRICAL WIRING AND CONNECTION INSTALLATION:

- A. Refer to DIVISION 26.

3.03 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.

3.04 ADJUSTING:

- A. Calibrating and Adjusting:
 1. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 2. Temperature:
 - a. Calibrate temperature switches to make or break contacts.
 3. Stroke and adjust control dampers without positioners, following the manufacturer's recommended procedure, so that damper is 100% open and closed.
 4. Provide diagnostic and test instruments for calibration and adjustment of system.
- B. Adjust initial temperature set points.

3.05 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to DIVISION 01.

END OF SECTION 230900

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Sheet metal materials.

1.03 REFERENCE STANDARDS:

- A. Applicable Standards (Latest Edition):
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. AAMA 2605-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 2. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
 - a. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality (ANSI).
 - 4. American Welding Society (AWS):
 - a. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.
 - 5. ASTM International (ASTM):
 - a. ASTM A36/A36M - Specification for Carbon Structural Steel.
 - b. ASTM A480/A480M - Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 - c. ASTM A492 - Specification for Stainless Steel Rope Wire.
 - d. ASTM A603 - Specification for Zinc-Coated Steel Structural Wire Rope.
 - e. ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - f. ASTM A1008/A1008M - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - g. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - h. ASTM B209M - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - i. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - j. ASTM C916 - Specification for Adhesives for Duct Thermal Insulation.
 - k. ASTM C920 - Specification for Elastomeric Joint Sealants.
 - l. ASTM C1071 - Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - m. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - n. ASTM E488 - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 6. Code of Federal Regulations (CFR):

SECTION 233113 – METAL DUCTS: continued

- a. 40 CFR - Protection of Environment, Chapter I - Environmental Protection Agency, Part 59 - "National Volatile Organic Compound Emission Standards for Consumer and Commercial Products," Subpart D - "National Volatile Organic Compound Emission Standards for Architectural Coatings."
 7. National Air Duct Cleaners Association (NADCA):
 - a. NADCA 1992 - Mechanical Cleaning of Non-Porous Air Conveyance System Components.
 - b. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems.
 8. NFPA:
 - a. NFPA 90A - Installation of Air Conditioning and Ventilating Systems (ANSI).
 9. The North American Insulation Manufacturers Association (NAIMA):
 - a. NAIMA AH124 - Fibrous Glass Duct Liner Standard.
 10. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. HVAC Duct Construction Standards - Metal and Flexible.
 - b. IAQ Guidelines for Occupied Buildings under Construction - Appendix G, Duct Cleanliness for New Construction Guidelines.
 11. Underwriters Laboratories, Inc. (UL):
 - a. UL 723 - Test for Surface Burning Characteristics of Building Materials.
- 1.04 PERFORMANCE/DESIGN CRITERIA:
- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- 1.05 SUBMITTALS:
- A. Shop Drawings:
 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Factory- and shop-fabricated ducts and fittings.
 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 4. Elevation of top of ducts.
 5. Dimensions of main duct runs from building grid lines.
 6. Fittings.
 7. Reinforcement and spacing.
 8. Seam and joint construction.
 9. Penetrations through fire-rated and other partitions.
 10. Equipment installation based on equipment being used on Project.
 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - B. Delegated-Design Submittal:
 1. Sheet metal thicknesses.
 2. Joint and seam construction and sealing.
 3. Reinforcement details and spacing.
 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - C. Welding Procedure Specification (WPS) and Welder Performance Qualification Record (WPQR)
 - D. Field quality-control reports.

SECTION 233113 – METAL DUCTS: continued

1.06 QUALITY ASSURANCE:

- A. Welding Qualifications: Qualify welding procedures, welders, and welding operators according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS:

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class, unless otherwise indicated.

2.02 SHEET METAL MATERIALS:

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- C. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Stainless steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

PART 3 - EXECUTION

3.01 DUCT INSTALLATION:

- A. Coordinate duct layout and duct accessory arrangement with Drawings. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system as required to accommodate control damper assembly.
- B. Install duct systems as indicated, unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," unless otherwise indicated.
- D. Install ducts with fewest possible joints.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- I. Install duct as necessary to mount fans and dampers.

3.02 INSTALLATION OF EXPOSED DUCTWORK:

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

SECTION 233113 – METAL DUCTS: continued

- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 PAINTING:

- A. Duct and support materials shall be coated in accordance with DIVISION 9.

3.04 DUCT SCHEDULE:

- A. Fabricate ducts with aluminum except as otherwise indicated and coat in accordance with DIVISION 7.

END OF SECTION 23 31 13

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Centrifugal wall ventilators.

1.03 REFERENCE STANDARDS:

- A. American Bearing Manufacturers Association (ABMA):
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings (ANSI).
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 2605-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. Air Movement and Control Association International, Inc. (AMCA):
 - 1. AMCA 99 - Standards Handbook.
 - 2. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 - 3. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data (ANSI).
- D. Air Movement and Control Association International, Inc./American Society of Heating, Refrigerating and Air-Conditioning Engineers (AMCA/ASHRAE):
 - 1. AMCA 210/ASHRAE 51 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI).
- E. NFPA:
 - 1. NFPA 70 - National Electrical Code.
- F. Underwriters Laboratories, Inc. (UL):
 - 1. UL 705 - Power Ventilators.

1.04 PERFORMANCE REQUIREMENTS:

- A. Project Altitude: Base fan-performance ratings on actual the following Project site elevations.
 - 1. Lee Creek WTP: 507 ft above sea level.
 - 2. Lake Fort Smith: 768 ft above sea level.

1.05 SUBMITTALS:

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

SECTION 233423 - HVAC POWER VENTILATORS: continued

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
 - C. Field quality-control reports.
 - D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.
- 1.06 QUALITY ASSURANCE:
- 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
 - C. UL Standards: Power ventilators shall comply with UL 705.
 - D. Fans shall be UL listed.
- 1.07 COORDINATION:
- A. Coordinate size and location of structural-steel support members.
 - B. Coordinate installation of equipment supports.
 - C. Coordinate sizes and locations of equipment supports and penetrations with actual equipment provided.
- 1.08 DELIVERY, STORAGE, AND HANDLING
- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
 - B. Disassemble and reassemble units, as required for moving to final location, according to the manufacturer's written instructions.
 - C. Lift and support units with manufacturer's designated lifting or supporting points.
- 1.09 MAINTENANCE:
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

- 2.01 CENTRIFUGAL WALL VENTILATORS:
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Aerovent; a division of Twin City Fan Companies, Ltd.
 2. Greenheck Fan Corporation.
 3. Hartzell Fan, Incorporated.
 4. Loren Cook Company.
 5. PennBarry.
 - B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
 - C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

SECTION 233423 - HVAC POWER VENTILATORS: continued

- D. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50%.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 - 4. Wall Grille: Ring type for flush mounting.
 - 5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- E. Capacities and Characteristics: Refer to Fan Schedule on Drawings.
- F. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70% PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- G. 1. Color and Gloss: As selected by Architect/Engineer from manufacturer's full range.

2.02 MOTORS:

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- B. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in DIVISION 26 Sections.

2.03 SOURCE QUALITY CONTROL:

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install power ventilators level and plumb.
- B. Install units with clearances for service and maintenance

3.02 CONNECTIONS:

- A. Ground equipment according to DIVISION 26.
- B. Connect wiring according to DIVISION 26.

3.03 FIELD QUALITY CONTROL:

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.

SECTION 233423 - HVAC POWER VENTILATORS: continued

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Adjust damper linkages for proper damper operation.
 5. Verify lubrication for bearings and other moving parts.
 6. Verify that automatic control dampers in connected ductwork systems are in fully open position.
 7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 8. Shut unit down and reconnect automatic temperature-control operators.
 9. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Prepare test and inspection reports.

3.04 ADJUSTING:

- A. Adjust damper linkages for proper damper operation.
- B. Replace fan and motor pulleys as required to achieve design airflow.
- C. Lubricate bearings.

END OF SECTION 233423

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. This Section includes:
 - 1. Propeller unit heaters with electric-resistance heating coils.
- 1.03 REFERENCE STANDARDS:
- A. Applicable Standards (Latest Edition):
 - 1. Air-Conditioning, Heating, & Refrigeration Institute (AHRI):
 - a. AHRI 440 - Room Fan Coils.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality (ANSI).
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA):
 - a. ASHRAE/IESNA 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings (ANSI).
 - 4. NFPA:
 - a. NFPA 70 - National Electrical Code.
 - b. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 - c. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems (ANSI).
 - 5. Underwriters Laboratories, Inc. (UL):
 - a. UL 1995 - Heating and Cooling Equipment.
 - b. UL 2021 - Fixed and Location-Dedicated Electric Room Heaters.
- 1.04 SUBMITTALS:
- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
 - B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - C. Field quality-control test reports.
 - D. Operation and Maintenance Data: For unit heaters to include in emergency, operation, and maintenance manuals.
- 1.05 QUALITY ASSURANCE:
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

SECTION 238239 – UNIT HEATERS: CONTINUED

PART 2 - PRODUCTS

2.01 PROPELLER UNIT HEATERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Brasch.
 - 3. Daikin Applied.
 - 4. Modine Manufacturing Company.
 - 5. Indeeco.
 - 6. Trane.
- B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.
- D. Cabinet: Removable panels for maintenance access to controls.
- E. Cabinet Finish: Stainless steel, 16 gauge.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- G. Discharge Louver: Adjustable fin diffuser for horizontal units.
- H. General Coil Requirements: Test and rate propeller unit heater coils according to ASHRAE 33.
- I. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in industrial grade type 316 stainless steel tubular elements with stainless steel fins. Element ends shall be enclosed in corrosion resistant terminal box. Fin surface temperature shall not exceed 550° F (288° C) 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.
- J. Fan: Propeller type, direct driven, totally enclosed powder-coated aluminum fan blade fitted to fan motor assembly.
- K. Fan Motors: Comply with requirements in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 1. Totally enclosed, epoxy-coated, UL recognized motor with permanently lubricated ball bearings and factory wired to NEMA 4X enclosure.
- L. Control Devices:
 - 1. Unit provided, corrosion resistant thermostat, with range of 40° F to 100° F. Provide with low-voltage relay with transformer kit.
- M. Electrical Connection: Factory wired motors and controls for a single field connection with NEMA 4X disconnect switch.
- N. Capacities and Characteristics: As scheduled on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

SECTION 238239 – UNIT HEATERS: CONTINUED

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Install new filters in each fan-coil unit within two weeks of Substantial Completion.
- D. Install heaters to comply with manufacturer's clearance requirements.

3.03 CONNECTIONS:

- A. Ground equipment according to DIVISION 26.
- B. Connect wiring according to DIVISION 26.

3.04 FIELD QUALITY CONTROL:

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.05 ADJUSTING:

- A. Adjust initial temperature set points.

END OF SECTION 23 82 39

DIVISION 26 - ELECTRICAL

SECTION 26 05 10 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. DIVISION 01 for general administrative and procedural requirements.
- B. All Sections this Division.

1.02 SUMMARY:

- A. This Contract includes, but is not limited to, the following work components:
 - 1. Installation of wiring and associated connections to Equipment specified in this and all other Specification Divisions, unless indicated otherwise.

1.03 REFERENCE STANDARDS:

- A. Federal Information Processing Standards Publication (FIPS).
- B. National Electrical Contractors Association (NECA).
- C. National Electrical Installation Standards (NEIS): Except where the NEIS requirements specifically deviate from specific requirements of the NEC, the NEC shall take precedence.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA – 70 National Electrical Code (NEC).
- E. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE C2 – National Electrical Safety Code (NESC).
- F. Underwriters Laboratories (UL).

1.04 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Refer to each Section of this Division for specific Submittal requirements.
- C. Provide Conforming to Construction Records schematic diagrams and wiring diagrams.
- D. Provide product data on electrical material and products.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver products to the Project Site properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.06 WARRANTY:

- A. Provide a minimum one-year warranty on all electrical equipment. Warranty period shall begin when equipment is permanently energized or started unless specified otherwise. Contractor shall provide written notification to Owner's Representative prior to this warranty start date.

PART 2 - PRODUCTS

2.01 PRODUCTS:

- A. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of Underwriters Laboratories, Inc. (UL). Where UL requirements are not applicable, equipment and material shall be identified as such by Contractor and approved by Owner before purchase and installation.

SECTION 26 05 10 – GENERAL ELECTRICAL REQUIREMENTS: continued

2.02 ELECTRONIC EQUIPMENT COMPLIANCE:

- A. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

2.03 SYSTEMS TO BE INSTALLED:

- A. 480V, 3-phase, 60-hertz, 4-wire and 3-wire power systems.
- B. 208Y/120 V, 3 phase, 60 hertz, 4 wire lighting, convenience and small power system.
- C. Grounding systems.
- D. Underground conduit and duct bank system, including handholes.
- E. Instrumentation systems.
- F. Control systems.
- G. Temporary lighting and convenience power facilities during construction.

PART 3 - EXECUTION

3.01 ERECTION, INSTALLATION, APPLICATION:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. All electrical work and material shall comply with the following requirements:
 - 1. NFPA 70 - The National Electrical Code (NEC).
 - 2. IEEE C2, National Electrical Safety Code, Federal Information Processing Standards Publication (FIPS).
 - 3. NECA National Electrical Installation Standards (NEIS) (all except Table 1 of NECA 1).
 - 4. Coordinate electrical systems, equipment, and materials installation with other building components. Equipment motor horsepower sizes and kilowatt sizes shown are approximate. If equipment of a different size is furnished by Contractor, Contractor shall furnish and install the proper support equipment, motor starter, switchgear, feeders, fuses, circuit breaker, disconnect switch, wire, and conduit required for the equipment furnished, at no additional cost to Owner.
 - 5. Verify all existing dimensions by field measurements.
 - 6. Arrange for chases, slots, and openings in other building components during progress of construction to allow for electrical installations.
 - 7. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
 - 8. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building. Coordinate concrete pads, bases, roof curbs, and related items.
 - 9. Coordinate with all other building trades.
 - 10. Where mounting heights are not specifically detailed, specified, or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 11. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised

SECTION 26 05 10 – GENERAL ELECTRICAL REQUIREMENTS: continued

service companies, and controlling agencies. Provide required connection for each service.

12. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Should coordination requirements conflict with individual system requirements, refer conflict to Owner's Representative in writing.
 13. Install systems, materials, and equipment level, plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 14. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.
 15. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 16. All equipment and materials shall be installed in accordance with NFPA 70 - The National Electrical Code (NEC).
 17. All equipment conductor termination provisions shall be UL listed for 75°C conductors as minimum.
 18. Install raceways, cables, wireways, and busways clear of obstructions and clear of the required working space of equipment.
- C. Refer to each section of this Division for specific performance requirements.

3.02 TESTING:

- A. Test all electrical Equipment upon completion of installation to ensure that the Equipment operates satisfactorily and to conform to Contract Documents.
- B. Furnish temporary power source of proper type for testing purposes when normal supply is not available at the time of testing.

3.03 FINISHES:

- A. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit degree of damage at each location.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
- C. Touch-up paint color shall match factory coatings.
- D. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- E. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- F. Repair damage to protective coatings in accordance with Section 09 90 00 - Protective Coatings.

3.04 CLEANING:

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

3.05 PROTECTION:

- A. Protect equipment and installations and maintain conditions to ensure that coatings, finishes and cabinets are without damage or deterioration at time of Substantial Completion.

SECTION 26 05 10 – GENERAL ELECTRICAL REQUIREMENTS: continued

3.06 CLOSEOUT:

- A. Instructions, training, and manufacturer's service representative:
 - 1. Provide on-site instructions and training of Owner's personnel as specified.
 - 2. Provide on-site services of a manufacturer's authorized service representative as specified.

END OF SECTION 26 05 10.

SECTION 26 05 19 –ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes furnishing and installing (including terminations) of all electrical wire, cable, and accessories.
- B. Definition:
 - 1. Burns & McDonnell type designations, such as "CEV1," "SVN3" and "BC2" indicated or specified, are for identification purposes only and are not intended to correspond to any trade designation.

1.03 RELATED REQUIREMENTS:

- A. SECTION 26 05 26 – Grounding and Bonding for Electrical Systems.
- B. SECTION 26 05 33 – Raceways, Boxes, and Supports for Electrical Systems.
- C. SECTION 26 50 00 – Lighting.
- D. SECTION 40 91 00 – Instrumentation for Process Systems.
- E. SECTION 40 95 13 – Control Panels and Hardware.

1.04 REFERENCE STANDARDS:

- A. American Society for Testing and Materials (ASTM):
 - 1. B3 – Soft or Annealed Copper Wire.
 - 2. B8 – Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 3. B33 – Tinned Soft or Annealed Copper Wire for Electrical Purposes.
 - 4. B172 – Rope Lay Stranded Copper Conductors, Having Bunch Stranded Members, for Electrical Conductors.
- B. Insulated Cable Engineers Association (ICEA):
 - 1. S-81-570 – 600-Volt Rated Cables of Ruggedized Design for Direct Burial Installations as Single Conductors or Assemblies of Single Conductors.
 - 2. S-105-692 – 600-Volt Single Layer Thermoset Insulated Utility Underground Distribution Cables.
 - 3. T-29-520 – Vertical Cable Tray Flame Tests at 210,000 BTU.
- C. National Electric Manufacturers Association (NEMA) and Insulated Cable Engineers Association (ICEA):
 - 1. WC55/S-82-552 – Instrumentation Cables and T.C. Wire.
 - 2. WC57/S-73-532 – Standard for Control Cables.
 - 3. WC70/S-95-658 – Power Cables Rated 2000V or Less.
- D. International Electrical Testing Association (NETA):
 - 1. NETA Acceptance Testing Specification – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- E. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC).
- F. Underwriters Laboratories, Inc. (UL):
 - 1. 44 – Rubber Insulated Wires and Cables.
 - 2. 83 – Thermoplastic Insulated Wires and Cables.
 - 3. 263 – Fire Tests of Building Construction and Materials.
 - 4. 854 – Service Entrance Cables.

SECTION 26 05 19 – ELECTRICAL POWER CONDUCTORS AND CABLES: continued

5. 1277 – Electrical Power and Control Tray Cables with Optional Optical Fiber Members.

1.05 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Product Data: Submit the following for each type of product specified and included as minimum:
 - 1. Data sheets for each wire and cable type specified.
 - 2. Data sheets for wire and cable connectors and other accessories.
 - 3. Cable manufacturer's installation requirements such as maximum pulling tensions, sidewall pressures, minimum bending radii, and other considerations.
 - 4. Other Equipment and Materials to be used.
- C. Test and Evaluation Reports:
 - 1. Factory test reports.
 - 2. Field test reports.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Wire and Cable: Acceptable manufacturers for each wire and cable type will be manufacturers that have been manufacturing the specified cable for a minimum of five years and meet all the requirements listed on the Wire and Cable Specification Sheets.
- B. Cable Connectors for Control and Instrument Cable:
 - 1. TE Connectivity Ltd.
 - 2. Hollingsworth.
 - 3. Panduit Corporation.
 - 4. 3M Company.
 - 5. Thomas & Betts, ABB Group.
- C. Cable Connectors for Power Cable:
 - 1. TE Connectivity Ltd.
 - 2. Thomas & Betts, ABB Group.
 - 3. 3M Company.
 - 4. Panduit.
- D. Termination and Splice Kits:
 - 1. 3M Company.
 - 2. Raychem.
- E. Tape and Insulation Putty:
 - 1. 3M Company.
- F. Cable Ties:
 - 1. TE Connectivity Ltd.
 - 2. Avery Dennison Corporation.
 - 3. Panduit Corporation.
 - 4. 3M Company.
 - 5. Thomas & Betts, ABB Group.
- G. Cable Supports:
 - 1. O-Z/Gedney, Emerson Electric Company.
 - 2. Hubbell, Kellems Grips.
- H. Terminal Blocks:
 - 1. Allen Bradley.
 - 2. TE Connectivity Ltd.

SECTION 26 05 19 – ELECTRICAL POWER CONDUCTORS AND CABLES: continued

3. Phoenix Contact.
4. Square D, Schneider Electric.
5. Weidmuller.
- I. Cable Identification Tags:
 1. Allen Markings.
 2. Panduit.
 3. Specialty Products Company.
 4. Thomas & Betts, ABB Group.
- J. Cable Fire and Smoke Stop Fittings:
 1. Crouse-Hinds, Eaton.
 2. Nelson Electric.
 3. O-Z/Gedney, Emerson Electric Company.

2.02 WIRE AND CABLE:

- A. Wire and cable shall be furnished in accordance with the specification sheets at the end of this Section.

2.03 CONNECTORS:

- A. General Requirements:
 1. Designed and sized for specific cable being connected.
 2. Solderless, pressure type connectors constructed of non-corrodible tin plated copper.
 3. Application tooling for connectors shall contain die or piston stops to prevent over crimping and cycling or pressure relief to prevent under crimping. Dies of all application tooling shall provide dot or wire size coding for quality control verification. All tooling shall be manufactured by the connector manufacturer.
- B. Power Connectors (10 AWG and Smaller) 600V and Below:
 1. "Scotchlok" pre-insulated spring wire connectors.
 2. Buchanan open end copper splicing caps, applied with "Lok Seal" tool, with nylon snap on insulators.
- C. Power Connectors (sizes 8 – 4 AWG) 600V and Below:
 1. Noninsulated ring tongue type.
 2. Ring tongue sized to match terminal stud size.
 3. Brazed barrel seam.
 4. Application tooling designed to crimp the wire barrel (conductor grip) with a one-step crimp.
- D. Power Connectors (sizes 2 AWG – 750 MCM) 600V and Below:
 1. Non-insulated one hole rectangular tongue for sizes 2 AWG through 3/0 AWG and two hole rectangular tongue for 4/0 AWG through 750 MCM.
 2. Application tooling shall be hydraulically operated.
- E. Control, Instrument, and Specialty Cable Connectors:
 1. Tin plated copper.
 2. Vinyl or nylon pre-insulated ring tongue type. Spade lugs will not be permitted.
 3. Sized to match terminal stud size.
 4. Have insulation grip sleeve to firmly hold to cable insulation.
 5. Insulation grip sleeve shall be funneled to facilitate wire insertion and prevent turned back strands.
 6. Application tooling designed to crimp the wire barrel (conductor grip) and the insulation grip sleeve with a one-step crimp.

SECTION 26 05 19 – ELECTRICAL POWER CONDUCTORS AND CABLES: continued

- 2.04 MOTOR LEAD TERMINATION/SPLICE (LOW VOLTAGE, 600V AND BELOW, POWER CABLE):
- A. Splices shall be made using compression type connectors bolted together. The compression type connectors shall be properly sized for the cables. Reference acceptable connector manufacturer's cross reference chart.
 - B. Splice to be covered with heat shrinkable tubing connector insulators or slip-on rubber boot or sleeve.
 - C. Splicing shall be done in accordance with the instructions provided with the Raychem brand MCK Motor Connector Kit or 3M Company 5300 Series Motor Lead Splice Kit.
- 2.05 CABLE SUPPORTS:
- A. Cable supports for cables in vertical conduit risers shall be O. Z/Gedney Type "R" wedging plug type or approved equal.
 - B. Where indicated provide stainless steel Kellems basket type wire mesh grips.
- 2.06 CABLE TIES:
- A. Nylon self-locking type.
 - B. Have a normal service temperature range of 40°C to 85°C.
 - C. Be weather resistant type for outdoor use.
 - D. AMP Special Industries "AMP TY," Dennison Manufacturing Company "BAR LOK," Panduit Corporation "PAN TY," Thomas & Betts "TY RAP," or Minnesota Mining and Manufacturing 3M Brand cable ties.
- 2.07 TERMINAL BLOCKS:
- A. For mounting in terminal boxes:
 - 1. Designed and sized for the cables being terminated.
 - 2. Block rated 600V.
 - 3. Binding screw type terminals for power cables and strap screw or tubular clamp terminals for control and instrument cables.
 - 4. Rated current carrying capacity equal to or greater than the cable being terminated.
 - 5. Marking strip.
 - B. For Mounting in Cabinets, Panels, etc.:
 - 1. Designed and sized for the cables being terminated.
 - 2. Block rated 600V.
 - 3. Binding screw type terminals for power cables and current transformer circuits and strap screw or tubular clamp terminals for control and instrument cables.
 - 4. Rated current carrying capacity equal to or greater than the cable being terminated.
 - 5. Marking strip on blocks for power cables and control and instrument cables.
 - 6. Short circuit strips with one shorting screw for each terminal for current transformer circuits.
- 2.08 CABLE IDENTIFICATION TAGS:
- A. Designed to provide a permanent wire and cable identification system.
 - B. Show complete cable number. Cable numbers are defined in the Cable Schedule and/or Contract Drawings.
 - C. Cable numbers may be stamped or typed, but shall be legible and permanent.
 - D. Character size for cable numbers shall be a minimum of 3/16 inch if hand lettered or 1/8 inch if stamped or typed.
 - E. Material shall be nonmetallic and impervious to moisture.

SECTION 26 05 19 – ELECTRICAL POWER CONDUCTORS AND CABLES: continued

- F. Be securely attached to cables and accessible for inspection.
- G. Cable identification tags, marking and attachment methods shall be subject to approval of Engineer.

2.09 CABLE FIRE AND SMOKE STOP FITTINGS:

- A. Rating shall equal or exceed the fire rating of the fire wall, floor, or ceiling penetrated.
- B. Fitting shall be sized for cable diameter and quantity of cable installed.
- C. Fitting shall be UL labeled.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General Requirements:
 - 1. Install in conduit or duct system as indicated.
 - 2. Do not subject cable to pulling tensions or sidewall pressures in excess of manufacturer's recommendations.
 - 3. Attach pulling grips over the cable sheath to prevent slipping of the insulation.
 - 4. Do not subject cable or duct system to bending radius less than those recommended by the cable manufacturer or as noted below (whichever is greater) during or after installation:
 - a. Eight times the cable outside diameter for 600V or lower rated cables.
 - 5. Install intermediate pull boxes as indicated or as required to avoid subjecting cable to excessive pulling tension or sidewall pressures.
 - 6. Support cables at connections or termination points such that any strain on cable will not be transmitted to the connection or termination.
 - 7. Install cable supports in vertical runs of conduit, at boxes and at terminations in equipment, and as required to meet intermediate support requirements of National Electrical Code (NEC).
 - 8. All pulling compounds shall be approved by wire and cable manufacturer as being compatible with cable materials.
 - 9. Attach a cable identification tag to each cable at all termination or end points.
 - 10. Install fire and smoke stop fittings at all cable penetrations of fire rated walls, floors, and ceilings.
- B. Power (600V and Below), Control, Instrument, and Specialty Cable:
 - 1. Install metallic barrier in all tray and boxes to separate power, control, and instrumentation from low level signal (50V or less) instrumentation circuits where run in the same tray or box.
 - 2. Secure with cable ties in cable tray risers at intervals not to exceed 3 feet.
 - 3. Tie together with cable ties all single conductor cable on each individual circuit in each junction box, equipment or manhole, and in cable tray, at intervals not to exceed 6 feet.
 - 4. Attach a cable identification tag to each cable.
 - a. At each terminal to identify the circuit and cable.
 - b. Attach fiber tags with cable ties.
 - c. Use nylon ties and identification tabs color coded as follows:
 - (1) 480V circuits – Red.
 - (2) 277, 240, or 208Vac circuits – Orange.
 - (3) 120V circuits – White.
 - (4) Control cables – Natural Nylon.
 - 5. Insulation Color Coding for Phase Identification:

SECTION 26 05 19 – ELECTRICAL POWER CONDUCTORS AND CABLES: continued

- a. Color code 600-volt insulated, service entrance, feeder, and branch circuit conductors with factory-applied colored insulation for No. 8 AWG and smaller (except: No. 6 AWG and smaller for green ground wire); 1-inch band of colored tape at all splices and terminations for No. 6 AWG and larger (except: No. 4 AWG and larger for green ground wire) as follows:

| <u>Phase</u> | <u>208Y/120 Volts</u> | <u>480Y/277 Volts</u> |
|--------------|-----------------------|-----------------------|
| A | Black | Brown |
| B | Red | Orange |
| C | Blue | White |
| Neutral | White | Gray |
| Ground | Green | Green |

- 6. Tag each individual conductor or wire with wire markers as follows:
 - a. With terminal designation indicated on schematic diagrams or given on manufacturer's equipment drawings.
 - b. At each terminal.
 - c. In addition to specified circuit tags.
- 7. Terminate and ground, control, instrument, and specialty cable shields as indicated and recommended by the manufacturer of the equipment being connected. In general, ground the shields at the PLC cabinet.
- 8. Control and instrument cable splices shall be as follows:
 - a. Made only in junction or terminal boxes.
 - b. Made on terminal blocks with marking strips, prior to cable installation.
 - c. Conductor color coding shall be maintained.
 - d. For shielded cables, shield continuity and isolation shall be maintained.
- 9. Power cable (600V or below) splices and motor terminations shall be as follows:
 - a. Made only in junction or terminal boxes.
 - b. Splices shall be made using compression type connectors bolted together.
 - c. Splice to be covered with a heat shrinkable connector insulator.
- 10. Lighting Cable: Install as specified and indicated.
- 11. Ground Cable: Install as specified and indicated.
- 12. Communications Cable: Install as specified and indicated.
- 13. Instrumentation Cable: Install as specified and indicated.
- C. Cable Connections and Terminations:
 - 1. Make up clean and tight to assure a low-resistance joint.
 - 2. Make only in terminal boxes, equipment or other accepted enclosures and not in conduit.
 - 3. Install all connectors with tooling manufactured by the connector manufacturer and as specified.

3.02 PROTECTION:

- A. Protect installed wire and cable from damage due to ongoing construction activities after initial installation.
- B. Wire and cable that is damaged shall be replaced prior to final acceptance.

3.03 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Services: Provide as specified in DIVISION 01.
- B. Perform tests and inspections and prepare test reports. Submit test reports as specified.
- C. Testing:

SECTION 26 05 19 – ELECTRICAL POWER CONDUCTORS AND CABLES: continued

1. Prior to energizing circuits, test wire and cables for electrical continuity and for short-circuits. Ensure proper polarity of connections is maintained.
2. Prior to energizing, check all installed feeders, building service wires and cables, and control cables with insulation megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Record and submit all field test data. Megger 300V cables with 500Vdc megohm meter between each conductor and ground. Megger 600V cables with 1,000Vdc megger between each conductor and ground. Also, megger between adjacent conductors. Megger cables after installation (not on cable reel) with cables disconnected at both ends. The values must be approximately as follows:

| <u>Conductor Size (AWG or MCM)</u> | <u>Resistance (Megohms-1,000 ft.)</u> |
|--|---|
| 14 - 8 | 200 |
| 6 - 2/0 | 100 |
| 3/0 - 500 | 50 |

3. Do not test wires or cables with an ac test set.
 4. Do not connect motors and transformers during meggering.
 5. Provide all phasing tests and make all changes necessary to assure proper rotation of all motors, the correct phasing and phase sequence of all circuits susceptible to being paralleled, the proper polarity on all instrument transformer wiring, and such other phasing tests as may be required for the equipment being connected under this Contract.
 6. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- D. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace damaged or malfunctioning cables and retest as specified above.

END OF SECTION 26 05 19

**Burns & McDonnell Engineering Company
Engineers - Architects - Consultants
Kansas City, Missouri**

BC2

B&McD TYPE:

NEC TYPE:

BARE COPPER GROUND CABLE

GENERAL REQUIREMENTS:

Annealed, tin-coated, bare copper (ASTM B33)

SPECIFIC REQUIREMENTS:

1. Solid in sizes 4 AWG and smaller.
2. Class B stranded in sizes 2 AWG and larger (ASTM B8).

| | | |
|---|---|-------------------------------|
| Burns & McDonnell Engineering Company Engineers - Architects - Consultants Kansas City, Missouri | WIRE AND CABLE SPECIFICATION SHEET | |
| | CEV1 B&McD TYPE: | TC NEC TYPE: |

600 VOLT - UNSHIELDED MULTI-CONDUCTOR CONTROL CABLE

GENERAL REQUIREMENTS:

- CONDUCTOR:** Class B or C stranded annealed copper (NEMA WC57/ICEA S-73-532 Part 2).
- INSULATION:** Cross-linked polyethylene “XLPE” (NEMA WC57/ICEA S-73-532 Part 3) and rated as Type XHHW-2. Color coding shall be Method 1 (NEMA WC57/ICEA S-73-532 Appendix E, Para. E3.1) using color pigmented compounds with colors as designated by Table E-2 (K-2).
- CABLE JACKET:** Polyvinyl chloride “PVC” (NEMA WC57/ICEA S-73-532 Part 4.2) and rated for outdoor use.
- IDENTIFICATION:** Surface printing on the cable shall show manufacturer’s name, cable type (TC), insulation type (XHHW-2), number and size of conductors, voltage rating, and Underwriters Laboratories label (UL).

SPECIFIC REQUIREMENTS:

TEMP. RATING: Cable shall be suitable for operation under the following maximum conductor temperatures:
90°C --- Continuous, wet or dry locations

CONDUCTOR SIZE #14 AWG

| | | |
|------------------------------|--|---|
| INSULATION THICKNESS: | Conductor Size <u>(AWG)</u> #14 | Insulation Thickness (Mils) (NEMA WC57/ICEA S-73-532 <u>Table 3-1)</u> 30 |
|------------------------------|--|---|

| | | |
|--------------------------|--|---|
| JACKET THICKNESS: | Calculated Diameter of Cable Under <u>Jacket (inches)</u> 0.425 or less 0.426-0.700 0.701-1.500 1.501-2.500 2.501 or larger | Jacket Thickness (Mils) (NEMA WC57/ICEA S-73-532 <u>Table 4-1)</u> 45 60 80 110 140 |
|--------------------------|--|---|

FACTORY TESTS: All cable shall be tested in accordance with requirements of NEMA WC57/ICEA S-73-532 Part 6, ICEA 210,000 BTU flame test (ICEA T-29-520), and UL1277.

CERTIFICATION: Cables shall be certified to be in conformance with all applicable requirements of NEMA WC57/ICEA S-73-532, ICEA T-29-520, and UL1277.

| | | |
|---|---|-------------------------------|
| Burns & McDonnell Engineering Company Engineers - Architects - Consultants Kansas City, Missouri | WIRE AND CABLE SPECIFICATION SHEET | |
| | IVV1 B&McD TYPE: | TC NEC TYPE: |

**600 VOLT - SHIELDED INSTRUMENT CABLE
(WITH SHIELDED TWISTED PAIRS/TRIADS)**

GENERAL REQUIREMENTS:

- CONDUCTOR: Class B stranded annealed copper (NEMA WC55/ICEA S-82-552 Part 2).
- INSULATION: Polyvinyl chloride "PVC" (NEMA WC55/ICEA S-82-552 Part 3). Color code shall use pigmented compounds as follows one conductor coded white, the second conductor coded black, and if the cable is for a triad, the third conductor shall be coded red. Each pair or triad will be sequentially number by surface printing.
- CONDUCTOR JACKET: Nylon (NEMA WC55/ICEA S-82-552 Part 3)
- PAIR SHIELD: Aluminized mylar or polyester tape with tinned copper drain wire.
- SHIELD ISOLATION TAPE: Mylar or polyester tape.
- CABLE SHIELD: Aluminized mylar or polyester tape with tinned copper drain wire.
- CABLE JACKET: Polyvinyl chloride "PVC" (NEMA WC55/ICEA S-82-552 Part 4).
- IDENTIFICATION: Surface printing on the cable jacket shall show manufacturer's name, cable type (TC), insulation type, conductor type, voltage rating, and Underwriters Laboratories label (UL).

SPECIFIC REQUIREMENTS:

- TEMP. RATING: Cable shall be suitable for operation under the following maximum conductor temperatures:
90°C
- CONDUCTOR SIZE: #18 AWG.
- INSULATION THICKNESS: All conductors to have 25 mils nominal insulation (NEMA WC55/ICEA S-82-552, Table 3-1).

JACKET THICKNESS:

| Calculated Diameter of Assembly Under Jacket (inches) | Jacket Thickness (Mils) (NEMA WC55/ICEA S-82-552, Table 4-1) |
|---|---|
| 0.425 or less | 45 |
| 0.426-0.700 | 60 |
| 0.701-1.500 | 80 |
| 1.501-2.500 | 110 |
| 2.501 or larger | 140 |

- FACTORY TESTS: All cable shall be tested in accordance with requirements of NEMA WC55/ICEA S-82-552 Part 6, ICEA 210,000 BTU flame test (ICEA T-29-520), and UL1277.
- CERTIFICATION: Cables shall be certified to be in conformance with all applicable requirements of NEMA WC55/ICEA S-82-552, ICEA T-29-520, and UL1277.

WIRE AND CABLE SPECIFICATION SHEET

Burns & McDonnell Engineering Company
Engineers - Architects - Consultants
Kansas City, Missouri

SE2

XHHW-2

B&McD TYPE:

NEC TYPE:

600 VOLT - SINGLE CONDUCTOR - POWER CABLE

GENERAL REQUIREMENTS:

CONDUCTOR: Class B stranded annealed copper (NEMA WC70/ICEA S-95-658 Section 2).

INSULATION: Cross-linked polyethylene "XLPE" (NEMA WC70/ICEA S-95-658 Section 3).

IDENTIFICATION: Surface printing on the cable shall show manufacturer's name, insulation type (XHHW), conductor size, conductor type, voltage rating, and Underwriters Laboratories label (UL).

SPECIFIC REQUIREMENTS:

TEMP. RATING: Cable shall be suitable for operation under the following maximum conductor temperatures:
90°C --- Continuous, wet or dry locations

MATERIAL THICKNESS:

| <u>Conductor Size</u> <u>(AWG or MCM)</u> | <u>Insulation</u> <u>Thickness (Mils)</u> <u>(NEMA WC70/ICEA S-95-658</u> <u>Table 3-4)</u> |
|--|--|
| 14-9 | 30 |
| 8-2 | 45 |
| 1-4/0 | 55 |
| 250-500 | 65 |
| 550-1000 | 80 |
| 1100-2000 | 95 |

FACTORY TESTS: All cable shall be tested in accordance with requirements of NEMA WC70/ICEA S-95-658 Section 6, and UL44.

CERTIFICATION: Cables shall be certified to be in conformance with all applicable requirements of NEMA WC70/ICEA S-95-658, and UL44.

WIRE AND CABLE SPECIFICATION SHEET

Burns & McDonnell Engineering Company
Engineers - Architects - Consultants
Kansas City, Missouri

SVN3**B&McD TYPE:****THHN/THWN****NEC TYPE:****600 VOLT - SINGLE CONDUCTOR - POWER CABLE****GENERAL REQUIREMENTS:**

CONDUCTOR: Class B stranded annealed copper (NEMA WC70/ICEA S-95-658 Section 2).

INSULATION: Polyvinyl chloride "PVC" (NEMA WC70/ICEA S-95-658 Section 3).

CONDUCTOR JACKET: Nylon (NEMA WC70/ICEA S-95-658 Section 4)

IDENTIFICATION: Surface printing on the cable shall show manufacturer's name, insulation type (THHN), conductor size, conductor type, voltage rating, and Underwriters Laboratories label (UL).

SPECIFIC REQUIREMENTS:

TEMP. RATING: Cable shall be suitable for operation under the following maximum conductor temperatures:
 90°C --- Continuous, dry locations
 75°C --- Continuous, wet locations

INSULATION THICKNESS:

| Conductor Size (AWG or MCM) | Insulation | Jacket |
|--------------------------------|---|---|
| | Thickness (Mils) (NEMA WC70/ICEA S-95- 658 Table 3-5) | Thickness (Mils) (NEMA WC70/ICEA S-95- 658 Table 3-5) |
| 14-11 | 15 | 4 |
| 10, 9 | 20 | 4 |
| 8-5 | 30 | 5 |
| 4-2 | 40 | 6 |
| 1-4/0 | 50 | 7 |
| 250-500 | 60 | 8 |
| 550-1000 | 70 | 9 |

FACTORY TESTS: All cable shall be tested in accordance with requirements of NEMA WC70/ICEA S-95-658 Section 6, UL83, and UL1581.

CERTIFICATION: Cables shall be certified to be in conformance with all applicable requirements of NEMA WC70/ICEA S-95-658, UL83, and UL1581.

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section specifies electrical grounding and bonding as indicated on Drawings and schedules and as specified herein. Grounding and bonding Work is defined to encompass systems, circuits, and equipment.
- B. Type of electrical grounding and bonding Work specified in this Section includes the following:
 - 1. Solidly grounded. Grounded through a ground connection in which no impedance has been intentionally inserted.
- C. Applications of electrical grounding and bonding Work in this Section include the following:
 - 1. Metal underground water piping.
 - 2. Metal building frames.
 - 3. Electrical power systems.
 - 4. Grounding electrodes.
 - 5. Counterpoise grounding loops.
 - 6. Separately derived systems.
 - 7. Raceways.
 - 8. Service equipment.
 - 9. Boxes and enclosures.
 - 10. Equipment.
 - 11. Lighting standards and poles.
- D. Refer to other DIVISION 26 Sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding Work; not Work of this Section.

1.03 RELATED REQUIREMENTS:

- A. Section 26 05 33 – Raceways, Boxes, and Supports for Electrical Systems.
- B. Section 26 05 53 – Identification for Electrical Systems.
- C. Section 31 23 33 – Trenching and Backfilling for Utilities.

1.04 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. American Society for Testing and Materials (ASTM):
 - 1. B3 – Soft or Annealed Copper Wire.
 - 2. B8 – Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 3. B33 – Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
- C. Institute of Electrical and Electronic Engineers (IEEE): Comply with applicable requirements and recommended installation practices of the following IEEE Standards pertaining to grounding and bonding of systems, circuits, and equipment:
 - 1. 80 – Guide for Safety in Substation Grounding.
 - 2. 81 – Guide for Measuring Ground Resistance, and Potential Gradient in the Earth.
 - 3. 141 – Recommended Practice for Electric Power Distribution for Industrial Plants.
 - 4. 142 – Recommended Practice for Grounding Industrial and Commercial Power Systems.

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: continued

- D. National Electrical Contractors Association (NECA) Installation Standards.
- E. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC): Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits, and equipment.
- F. Underwriters Laboratories (UL): Comply with applicable requirements of the following standards. Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
 - 1. 467 – Electrical Grounding and Bonding Equipment.
 - 2. 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 3. 869 – Electrical Service Equipment.

1.05 SUBMITTALS:

- A. Refer to DIVISION 01 and Section 26 05 10 – General Electrical Requirements for administrative and procedural requirements for Submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's data on all grounding and bonding components and associated accessories.
 - 2. All field test reports.

1.06 QUALITY ASSURANCE:

- 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 UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide grounding and bonding products of one of the following (for each type of product):
 - 1. Grounding Products:
 - a. Advanced Lightning Technology, Ltd.
 - b. Anderson Electrical Products, Hubbell Inc.
 - c. Burndy LLC.
 - d. Cadweld, Erico International Corp.
 - e. Crouse-Hinds, Eaton.
 - f. Erico-International Corporation.
 - g. Copperweld Bimetallics, LLC.
 - h. Harger Lightning and Grounding.
 - i. Ideal Industries, Inc.
 - j. Joslyn, MacLean Power Systems.
 - k. Myers, Crouse-Hinds, Eaton.
 - l. O-Z/Gedney, Emerson Electric Company.
 - m. Preferred Lightning Protection, Inc.
 - n. Thomas & Betts, ABB Group.
 - o. Engineer-approved equal.

2.02 GROUNDING AND BONDING:

- A. Materials and Components:

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: continued

1. General: Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Contractor's code-compliance option. Where materials or components are not indicated, provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications.
2. Conductors:
 - a. Unless otherwise indicated, provide insulated electrical grounding conductors for equipment grounding conductor connections that match power supply wiring materials and as a minimum are sized according to the NEC.
 - b. Provide annealed, tin-coated, bare copper cable for ground electrode conductors, buried ground system conductors, and exposed ground system conductors.
 - c. Tin-coated ground conductors shall meet ASTM B8 and B33.
3. Service Surge Protection: Ground according to manufacturer's instructions.
4. Bonding Plates, Connectors, Terminals, and Clamps: Provide electrical bonding plates, connectors, terminals, lugs, and clamps as recommended by bonding plate, connector, terminal, and clamp manufacturers for indicated applications.
 - a. Bolted Connectors for Conductors and Pipes: Copper or copper-alloy, pressure type with at least two silicon bronze or stainless-steel bolts and lock washers.
 - b. Irreversible Compression Fittings: Pure wrought copper extrusion clamps and connectors, made to be held in the dies of an installation tool. Connectors must be factory filled with an oxide inhibitor.
 - c. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
 - d. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals and long-barrel, two-bolt connection to ground bus bar.
5. Ground Rods or Ground Electrodes:
 - a. Ground Rods: Copper-clad steel or copper-alloy, sectional type rods. One end pointed to facilitate driving, 3/4-inch diameter by 10 feet.
6. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type service required or indicated.
7. Mastic Coatings:
 - a. Sonneborn-Sonoshield Mastics (BASF Construction Chemicals LLC).
 - b. W.R. Meadows - Sealmastic.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standards of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements.
- B. A grounding electrode shall be installed at each building or structure as indicated.
 1. Grounding electrodes shall consist of the following:
 - a. Ground rod and cable system.
 - b. Concrete-encased electrode.

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: continued

- c. Grounded metal frame of the building or structure.
 - d. Metal underground water pipe.
 - e. Other systems or structures as indicated.
- C. Ground Rods:
- 1. Install rods as indicated by driving and not by drilling or jetting.
 - 2. Drive rods into unexcavated portion of the earth where possible.
 - 3. Where rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
 - 4. Drive to a depth such that top of rods will be approximately 18 inches below final grade or subgrade, and connect main grid ground cable thereto.
 - 5. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 6. Separation between ground rods shall be equal to or greater than the length of the rods.
 - 7. The ground electrode conductor shall not contain splices between the ground electrode and the service entrance equipment.
- D. Counterpoise Ring: Install as indicated.
- E. Grounding Conductors:
- 1. Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 2. Install using as few joints as possible. Route along shortest and straightest paths possible unless otherwise indicated or required by Code.
 - 3. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Suitably protect cable against damage during construction.
 - 4. Replace or suitably repair cable if damaged by anyone before final acceptance.
 - 5. In Exposed Installations:
 - a. Route runs as indicated.
 - b. Route along the webs of columns and beams, and in corners where possible for maximum physical protection.
 - c. Where physical protection is required, install in PVC conduit unless indicated otherwise.
 - d. Support at intervals of 3 feet or less with non-magnetic clamp-type supports.
 - 6. In Buried Installations:
 - a. Conductor sizes shall be as indicated for specific connections. For required connections not indicated, use conductor size not less than No. 3/0 AWG if buried in the earth or cast in concrete, or No. 6 AWG at other locations.
 - b. Lay in bottom of trench or in other excavations at the depth of the top of the ground rod.
 - c. Bury at least 30 inches (600 mm) below grade.
 - d. Maintain clearance of at least 12 inches from all underground metal piping or structures, except where connections thereto are specifically indicated.
 - e. Ground cable shall enter the bottom of electrical gear or panels sitting on a slab through a PVC sleeve.
 - 7. Backfill as specified in DIVISION 31.
- 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 any adjacent parts.

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: continued

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 a disconnect-type connection is required, use a bolted clamp or compression fitting.
- G. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors with silicon bronze or stainless-steel bolts and lock washers.
 2. Underground Connections: Provide exothermic welded connections where grounding conductors connect to underground grounding conductors and underground grounding electrodes.
 3. Clean metal contact surfaces of clamp-on connectors to ensure electrical conductivity and circuit integrity.
 4. Exothermic terminations:
 - a. Conform to manufacturer's instructions.
 - b. Chemically degrease and dry completely before welding.
 - c. Apply one coat of mastic coating to all exothermic-welded connections to be buried.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 2/0 AWG for a grounding conductor.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel mat in at least four locations using compression fittings designed for the intended purpose.
 3. The grounding connection to the supplemental electrode shall be bonded by either exothermic welding or irreversible compression fittings.
 4. Extend grounding conductor below grade and connect to building's grounding grid.
 5. Extend at least one Ufer ground to the grounding electrode external to the concrete.
 6. Welding Ufer ground directly to the structural reinforcing steel is prohibited.
- I. Grounding and Bonding of Metal Underground Water Pipe:
1. Metal Process Water Pipes:
 - a. For a small or medium-sized pipe, connect the pipe to the ground system at an exposed location using a mechanical bolted clamp connector with silicon bronze hardware.
 - b. Follow manufacturer's instructions for cleaning pipe and applying oxide inhibiting compound around perimeter of connector.
- J. All grounding system components shall be bonded to form one continuous grounding electrode.
- K. Ground electrical service system neutral at service entrance equipment to grounding electrodes.
- L. Ground each separately derived system neutral to the main building ground system:
- M. Bond the system neutral to service entrance equipment enclosures.
- N. Ground all exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductors in raceways and cables, receptacle ground conductors, and metallic plumbing systems.
- O. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: continued

- P. Apply mastic coating to field connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

3.02 INSTALLATION - EQUIPMENT GROUNDING:

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug on panelboard or control panel ground bus. When conduit enters from below and is not connected to the enclosure, ground equipment grounding conductor on conduit grounding bushing and then bond to ground bus (or grounded enclosure if there is no ground bus).
- C. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

3.03 INSPECTION:

- A. Do not cover up connections before they are inspected by Engineer.
- B. Compression-type connections shall be inspected for embossment of proper die index per manufacturer's instructions.

3.04 FIELD QUALITY CONTROL:

- A. Perform tests and inspections.
- B. 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 a calibrated torque wrench according to manufacturer's written instructions.
 - 3. All compression-type connections shall be inspected for proper die index number.
 - 4. Test completed grounding system at each location where a maximum ground-resistance level is specified.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any 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 according to IEEE 81 for the following:
 - (1) Testing and commissioning of new grounds, not yet connected to the utility power supply.
 - (2) Testing complex ground systems that include a metallic loop.
 - c. A clamp-on ground tester may only be used if the Owner does not require strict adherence to IEEE 81 and for the following situations:
 - (1) To test installed grounds without disconnecting them from the utility.
 - (2) To test a grounding electrode configuration where the return path includes the earth. (This does not include a ground system that includes a metallic loop.)
 - (3) To test the resistance of a single rod in a series or array.
 - (4) To check errant current flow to ground for operator safety.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed 5 ohms.

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: continued

- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. This Section includes all conduit, fittings and accessories.
- 1.03 RELATED REQUIREMENTS:
- A. DIVISION 31 – Trenching and Backfilling.
 - B. Section 26 05 10 – General Electrical Requirements.
 - C. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
 - D. Section 26 05 53 – Identification for Electrical Systems.
- 1.04 REFERENCE STANDARDS:
- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - B. American National Standards Institute (ANSI):
 - 1. A780 – Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 2. C80.1 – Rigid Steel Conduit, Zinc-Coated.
 - 3. C80.5 – Rigid Aluminum Conduit.
 - 4. E814 – Test Method for Fire Tests of Penetration Firestop Systems.
 - C. ASTM International:
 - 1. B241 – Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - D. Joint Industrial Council (J.I.C.):
 - 1. Comply with standards for Oil and Dust Tight Lay-In Wireway.
 - E. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC).
 - F. National Electrical Contractor’s Association (NECA):
 - 1. NECA-1 – Standard Practice of Good Workmanship in Electrical Construction.
 - G. National Electrical Manufacturers Association (NEMA):
 - 1. RN1 – Active Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 2. TC2 – Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 3. TC3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 4. TC6 and 8 – Polyvinyl Chloride (PVC) Plastic Utilities for Underground Installation.
 - 5. 250 – Enclosures for Electrical Equipment (1,000V Maximum).
 - H. Society of Protective Coatings (SSPC):
 - 1. SSPC-PA 1 – Shop, Field and Maintenance Painting of Steel.
 - 2. SSPC-SP3 – Power Tool Cleaning.
 - I. Underwriters' Laboratories, Inc. (UL):
 - 1. Provide all devices, components, and equipment that are UL listed and labeled.
 - 2. 6 – Electrical Rigid Metal Conduit - Steel.
 - 3. 6A – Electrical Rigid Metal Conduit - Aluminum, Bronze, and Stainless Steel.
 - 4. 50 – Standard for Enclosures for Electrical Equipment.
 - 5. 50E – Standard for Electrical Equipment Environmental Considerations.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

6. 360 – Liquid-Tight Flexible Steel Conduit.
7. 514A – Metallic Outlet Boxes.
8. 514B – Fittings for Cable and Conduit.
9. 651 – Schedule 40 and 80 Rigid PVC Conduit.

1.05 SUBMITTALS:

- A. Submit as specified in DIVISION 01 and Section 26 05 10 - General Electrical Requirements for administrative and procedural requirements for submittals.
- B. Submittals shall include, but not be limited to, the following:
 1. Product Data:
 - a. Submit manufacturer's technical product data, including specifications and installation instructions, for each type of product required. Include data substantiating that materials comply with requirements.
 - b. Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve, and seal.

1.06 QUALITY ASSURANCE:

- A. Comply with NFPA 70.
- B. Installations shall follow standard practices of NECA-1.

1.07 COORDINATION:

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete specifications.
- B. Coordinate installation of equipment supports and wall penetrations.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Rigid Galvanized-Steel Conduit (RGS):
 1. Allied Tube and Conduit Corporation.
 2. Fushi Copperweld.
 3. Western Tube and Conduit Corporation.
 4. Wheatland Tube Company.
 5. Republic Conduit, division of Maverick Tube Corporation.
- B. Fittings for Rigid Steel Conduit:
 1. Heavy-Duty Cast Malleable Iron Fittings:
 - a. Appleton Electric Company.
 - b. Crouse Hinds Company.
 - c. Thomas and Betts Corporation.
 2. Conduit Expansion and Deflection Fittings:
 - a. O.Z./Gedney Company.
 - b. Thomas and Betts Corporation.
- C. Rigid Steel Conduit and Fittings with Bonded Polyvinyl Chloride (PVC) Jacket:
 1. OCAL Inc.
 2. Robroy Industries.
- D. Rigid Aluminum Conduit:
 1. Allied Tube and Conduit; a Tyco Company.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

2. Indalex, Inc.
 3. New Jersey Aluminum Company.
 4. Phelps Dodge Cable and Wire Company.
 5. Republic Conduit; division of Maverick Tube Corporation.
 6. Thomas & Betts Corporation.
 7. Wheatland Tube Company.
 8. V.A.W. of America Inc.
- E. Rigid Aluminum Conduit Fittings:
1. Appleton Electric Company.
 2. Cooper Crouse-Hinds Company.
 3. Killark; division of Hubbell, Inc.
 4. Thomas & Betts Corporation.
- F. Rigid Polyvinyl Chloride (PVC) Conduit and Fittings:
1. IPEX Inc.
 2. Certain-Teed Products Corporation.
 3. Carlon Lamson and Sessions.
 4. Cantex Inc.
- G. Liquid-Tight Flexible Metal Conduit:
1. Anamet Electrical, Inc.
 2. Electri-Flex Company.
 3. Carol Company (div. of Allied Wire and Cable).
 4. Flexi-Guard Incorporated, O.Z./Gedney Company.
 5. Thomas & Betts Corporation.
- H. Outlet and Device Boxes:
1. Appleton Electric Company.
 2. Cooper Crouse-Hinds Company.
 3. Hubbell-Killark.
 4. Leviton.
 5. O-Z Gedney.
 6. Thomas & Betts Corporation.
- I. Pull and Junction Boxes:
1. Metallic Indoor and Outdoor Boxes:
 - a. Cooper B-Line.
 - b. Hoffman Engineering Company.
 - c. Hubbell Wiegmann.
- J. Conduit Hubs and Bodies:
1. Appleton Electric Company.
 2. Myers Industries, Inc. (ITT).
 3. Cooper Crouse-Hinds Company.
 4. O.Z. Gedney Company.
 5. Thomas & Betts Corporation.
- K. Wall Entrance Seals: O.Z./Gedney Company
- L. Fittings:
1. Cooper Crouse-Hinds Company.
 2. Appleton Electric Company.
 3. Thomas & Betts Corporation.
- M. Bushings, Grounding Bushings, and Locknuts:
1. Arrow Hart; Eaton.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

2. Appleton; EGS Electrical Group.
3. O-Z/Gedney; EGS Electrical Group.
4. Raco; Hubbell, Inc.
5. Steel City; Thomas & Betts Corp.
- N. Electrical Enclosures:
 1. Hoffman; Pentair Equipment Protection.
 2. Wiegmann; Hubbell, Inc.
- O. Anchor Manufacturers: Subject to compliance with requirements, provide anchors of one of the following manufacturers.
 1. Hilti, Inc.
 2. Ideal Industries, Inc.
 3. Joslyn Manufacturing Co., Inc.
 4. Eaton/Cooper; McGraw Edison Co.
 5. Unistrut; Atkore International.
- P. Metal Channel System Manufacturers: Subject to compliance with requirements, provide channel system of one of the following manufacturers.
 1. Allied Tube & Conduit Corp.; Power Strut Division.
 2. Eaton/Cooper; B-Line Systems, Industries.
 3. Erico International Corp.
 4. Kindorf; Thomas & Betts Corp.
 5. Power-Strut; Power Engineering Co.
 6. Superstrut; Thomas & Betts Corporation.
 7. Unistrut; Atkore International.
- Q. Inground Pull Boxes:
 1. Hubbell Power Systems.
 2. Engineer-approved equal.
- R. Firestopping:
 1. The 3M Company.
 2. Engineer-approved equal.
- S. Duct Seal:
 1. Ideal Industries, Inc.
 2. The 3M Company.
 3. Engineer-approved equal.
- T. Underground Type Plastic Line Marker:
 1. Brady.
 2. Engineer approved equal.

2.02 DESIGN REQUIREMENTS:

- A. Conduit:
 1. Each length of threaded conduit furnished with coupling on one end and metal or plastic thread protector on other end.
 2. UL listed and labeled conduit, on each length, fittings, and accessories.
 3. Sizes of conduit, fittings, and accessories as indicated, specified, or as required by Electrical Codes and Standards.
- B. Supports:
 1. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.03 RIGID GALVANIZED STEEL CONDUIT:

A. Raceway:

1. Conform to ANSI C80.1, and UL 6.
2. Mild ductile steel, circular in cross section with uniform wall thickness sufficiently accurate to cut clean threads.
3. Each length threaded on both ends with threads protected.
4. All scale, grease, dirt, burrs, and other foreign matter removed from inside and outside prior to application of coating materials.
5. Galvanized by the hot-dip process as follows:
 - a. Interior and exterior surfaces coated with a solid, unbroken layer of 99% virgin zinc by dipping.
 - b. Coating not to show fixed deposits of copper after four 1-minute immersions in a standard copper sulfate solution.
 - c. One coat of zinc-chromate finish on inside and outside surfaces to prevent oxidation and white rust.
6. Couplings and elbows fabricated, coated and finished by the same process as conduit.

B. Fittings:

1. Heavy-Duty Cast Malleable Iron Fittings:
 - a. Mogul type for conduit sizes 1-1/2 inches and larger.
 - b. LBD or roller action type LB for right-angle fittings for conduit sizes 2 inches and larger.
 - c. Full-threaded hubs and rubber-gasketed covers.
 - d. Zinc, cadmium-plated, or bronze hardware bolts and screws for assembly.
 - e. Finished with cadmium plating or galvanizing.
 - f. Form 8 bodies and covers.
 - g. Standard and junction fittings.
2. Conduit Expansion Fittings:
 - a. Line of Conduit Type:
 - (1) Galvanized expansion fittings for rigid conduit movement up to 4 inches.
 - (2) Insulated metal bushing on ends of the conduit, bonding jumper, and with expansion head sealed with a high-grade graphite packing.
 - (3) O.Z./Gedney Company, Type AX with Type AJ bonding jumper or Thomas and Betts Corporation, Type XJG.
 - b. End Type:
 - (1) For conduit terminating in a junction box.
 - (2) O.Z./Gedney Company, Type EXE with Type BJ-E bonding jumper.
3. Conduit Expansion and Deflection Fittings:
 - a. Provide for movement of 3/4 inch from normal in all directions between two rigid conduits.
 - b. Integral bonding jumper.
 - c. O.Z./Gedney Company, Type DX.
4. Conform to NEMA Type 1 enclosure in all nonhazardous areas except as specified or indicated otherwise.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

2.04 RIGID STEEL CONDUIT AND FITTINGS WITH BONDED POLYVINYL CHLORIDE (PVC) JACKET:

- A. Raceway:
1. Conform to hot-dipped galvanized rigid steel conduit as specified in RIGID STEEL CONDUIT, this Section, and as follows. Shall comply with NEMA RN1.
 2. PVC coating bonded to the conduit. Extruded PVC jackets are unacceptable.
 3. Coated externally with PVC to a nominal 40 mils, 0.035 inch to 0.045 inch.
 4. Uniformly coated around outside diameter and full length of the conduit.
 5. Pre-threaded ends coated with a urethane coating having a nominal thickness of 2 mils (0.002 inch).
 6. Interior surfaces of all conduits and feed-through fittings coated (except where prohibited by design) with a two-part, chemically cured, urethane coating having a nominal thickness of 2 mils (0.002 inch).
 7. The bond between the metal and jacket must exceed the tensile strength of the coating.
- B. Couplings, Elbows, and Fittings:
1. Couplings, elbows, and other conduit fittings, boxes, cover plates, supports, hardware, and related items shall be treated and coated with the same process as conduit.
 2. Each coupling and fitting to include a PVC sleeve that overlaps the conduit.
 3. Length of the overlapping sleeve equals diameter of the conduit or 2 inches, whichever is least.
 4. Final cured PVC coating capable of withstanding a minimum electrical potential of 2,000V.
 5. All conduit accessories, clamps, and hardware that are uncoated shall be stainless steel.
 6. All fittings intended for wet, outdoor, or wash-down application shall carry a NEMA 4X rating.
 7. Form 8 bodies and covers.

2.05 RIGID ALUMINUM CONDUIT:

- A. Raceway:
1. Fabricated from ASTM B241 alloy GS 10A, identical to Aluminum Association Alloy 6063. Shall meet UL 6A.
 2. All scale, dirt, grease, burrs, and other foreign matter removed prior to applying coating.
 3. Entire length coated with a special silicone lubricating compound compatible with wire and cable coverings to minimize wire drag.
 4. Each length threaded at both ends.
 5. Threads protected with a homogenized zinc dust petroleum lubricating compound to prevent seizure.
 6. Coupling and elbows fabricated from the same material as conduit and each treated as required for conduit.
 7. Couplings may use alloy 3003 in lieu of 6063.
- B. Fittings:
1. Heavy-duty cast, copper-free aluminum (less than 0.4%).
 2. Full threaded hubs.
 3. Rubber-gasketed covers of pressed or cast aluminum.
 4. Cadmium-plated or bronze hardware bolts and screws.
 5. LBD or roller action type LB for right-angle fittings for conduit sizes 2 inches and larger.
 6. Standard and junction fittings.
 7. Form 8 bodies and covers.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

2.06 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT:

- A. Fabricated from self-extinguishing high-impact polyvinyl chloride designed for aboveground and underground installations.
- B. Shall meet NEMA TC2, TC6 and TC8, and UL 651.
- C. Type EPC Schedule 40 heavy-wall rigid conduit.
- D. Fittings and accessories fabricated from same material as conduit. Shall meet NEMA TC3.
- E. Solvent-cement-type joints as recommended by manufacturer.

2.07 LIQUID-TIGHT FLEXIBLE METAL CONDUIT:

- A. Liquid-tight conduit with flexible galvanized-steel core and a synthetic rubber, polyvinyl chloride, or thermoplastic covering.
- B. Shall comply with UL 360.
- C. Spiral encased copper bonding conductors for conduit in sizes 1-1/4 inches and smaller.
- D. External grounding jumper as required.
- E. Provide hot-dipped galvanized fittings for connections to rigid steel conduit, and aluminum- or PVC-coated fittings for connections to PVC-coated rigid steel conduit.
- F. Fittings for flexible metal conduit shall comply with UL 514B.

2.08 OUTLET AND DEVICE BOXES:

- A. Surface Mounted:
 - 1. Cast hub device boxes for receptacles and switches.
 - 2. Cast aluminum. Metallic boxes shall meet UL 514A and NEMA OS 1.
 - 3. FS or FD single or multiple gang boxes as required.

2.09 PULL AND JUNCTION BOXES:

- A. Rigid Aluminum Conduit Boxes:
 - 1. For use in indoor and outdoor locations.
 - 2. Self-oxidizing, self-renewing aluminum alloy that is "copper-free" - less than 0.3 of 1% to assure resistance to corrosion, with a minimum wall thickness of 3/32 inch.
 - 3. Threaded conduit entrance with thread lubricant.
 - 4. Thoroughly cleaned to eliminate grease and other contaminates.
 - 5. Rubber or neoprene gasket for cover.
 - 6. Conform to NEMA Type 4X enclosures in all outdoor installations unless indicated otherwise.
 - 7. Interior mounting panel when used for enclosing terminal blocks and control relays.
 - 8. Box size as required by NEC or as indicated for each particular installation.
 - 9. Include provisions for mounting cable supports as indicated, specified or as required by NEC.
 - 10. Provide where indicated for cable pulling, junctions, terminals and for mounting of switches, outlets, and control devices.
- B. Metallic Barriers:
 - 1. Designed not to separate phases of a power circuit.
 - 2. Provide as indicated for the isolation of power circuits from other type circuits.
- C. Sealing Hub: Provide watertight, threaded, insulated sealing hub connectors for all outdoor and indoor wet locations where conduit enters into enclosures. Sealing hub threaded lengths shall be adequate to allow installation of bushing.
- D. Knockout Closures: Provide press-in knockout seals for all unused punched out knockouts 2 inches and smaller. Provide two-piece bolt on knockout seals for all unused punched out

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

knockouts 2-1/2 inches and larger. Closure material shall match rating of enclosure being sealed.

E. Hinged-Cover Enclosures:

1. Comply with UL 50 and NEMA 250, Type 12 aluminum or stainless steel for indoor locations and Type 4X aluminum or stainless steel for exterior locations with continuous-hinge cover with flush latch unless otherwise indicated.
 - a. Metal barriers to separate wiring of different systems and voltages.
2. Gasketed enclosures shall meet UL 50E.

2.10 CONDUIT WALL ENTRANCE SEALS:

- A. Provide where required or indicated.
- B. Use O.Z./Gedney Company Type FSK for new walls.
- C. Use O.Z./Gedney Company Type CSM for penetration in existing walls.

2.11 STEEL SUPPORT SYSTEM:

- A. General: Provide supporting devices which comply with manufacturer's standard materials, design, and construction in accordance with published product information, as required for complete installation, and as herein specified. All supports shall be designed for the support of the maximum number of conduits and their maximum conductor weights for maximum conduit loading. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option. Do not use perforated metal straps for supports.
- B. Fabricated from structural steel or manufactured framing members equal to "Unistrut" P-3000 (1-5/8 inch by 1-3/8 inch) series as manufactured by Unistrut Corporation, Kindorf B-995 (1-1/2 inch by 1-1/2 inch) series as manufactured by Thomas and Betts, or Superstrut A-1200 (1-5/8 inch by 1-5/8 inch) series as manufactured by Thomas and Betts.
- C. Minimum 12 gage.
- D. Construct as required to rigidly support all conduit runs, boxes, and equipment.
- E. Stainless-Steel Supports:
 1. Channel Type 304 stainless steel conforming to ASTM A240.
 2. Stainless-steel conduit clamps and hangers, sized for the specific conduit diameter.
 3. Provide stainless-steel rods, anchors, inserts, bolts, washers, nuts, and support hardware.
- F. Anchors: Anchors of types, sizes, and materials indicated, with the following construction features.
 1. Lead Expansion Anchors: 1/2, 5/8, or 3/4 inch as required.
 2. Toggle Bolts: Springhead, 3/16 by 4 inch or larger size as required.

2.12 INGROUND PULL BOXES:

- A. Boxes and cover shall be made of polymer concrete.
- B. Material shall be sunlight resistant, chemical resistant, moisture resistant, and non-conductive.
- C. The boxes shall be stable type for extra depth.
- D. The covers shall be heavy-duty and designed for 15,000 pounds over a 10-inch square with a minimum test load of 22,000 lbs. The covers shall be made of non-skid materials.
- E. Shall be designed for outdoor inground installation.
- F. Sizes as indicated on Contract Drawings. When not indicated sizes shall be as required by the National Electrical Code. Minimum size shall be 12 inches wide by 24 inches deep by 12 inches high. All mounting hardware shall be 316 stainless steel.
- G. Install where indicated or required for pulling purposes.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

2.13 FIRESTOPPING AND DUCT SEAL:

- A. Firestopping:
 - 1. Weather-resistant silicone sealant.
 - 2. Provide 4-hour fire rating.
 - 3. Provide flexible re-enterable and repairable seal around conduit.
 - 4. ANSI E814 tested system.
 - 5. Provide 3M[®] Fire Barrier 2000+ Silicone Sealant or Engineer-approved equal.
- B. Duct Seal:
 - 1. Noncorrosive, permanently soft compound.
 - 2. Nontoxic.
 - 3. Provide flexible re-enterable and repairable seal around cables in conduits.
 - 4. Prevent air movement and drafts through conduits.
 - 5. Provide Ideal Industries Duct Seal, 3M[®] Moldable Putty, or Engineer-approved equal.

2.14 UNDERGROUND PLASTIC LINE MARKER:

- A. Permanent, traceable, bright-colored, continuous-printed plastic tape marker, intended for marking below grade utilities.
- B. Provide tape marker with printing which most accurately indicates type of utility such as “Fiber Optic Cable Below” or “Electric Below.”
- C. Provide with continuous metal strip or core to allow nonmetallic conduits or fiber optic cables to be located.
- D. Manufactured by Brady or Engineer-approved equal.

2.15 GROUT:

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5,000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.16 SILICONE SEALANTS:

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Provide suitable protection for conduit risers against damage during construction.
- B. Cap ends of all conduits before concrete is poured.
- C. Cap all conduits after cleaning where conduits are to be left empty by this Contract.
- D. Carefully ream ends of all conduit lengths after cutting to eliminate sharp burrs.
- E. Clean out all conduits before pulling wire.
- F. Clean out all conduits immediately after concrete work is finished.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

3.02 RACEWAYS AND BOX INSTALLATION:

A. General Requirements:

1. Location:
 - a. Install conduit as near as possible to the routing indicated.
 - b. Shift locations as required to avoid interference with other equipment and piping being installed.
 - c. Where routing of conduit is not indicated, such as for lighting home run circuits and other systems requiring small conduit runs, route conduit as specified subject to approval by Engineer.
2. Do not use conduit in sizes smaller than 3/4 inch, except 1/2 inch may be used for connections to control devices where necessary.
3. Holes and Sleeves:
 - a. Provide through floors, walls, and roofs as necessary for conduit runs, including approved flashing and weather proofing at outside walls and on roofs.
 - b. Install sleeves or forms for all openings in new Work.
 - c. Provide the required inserts and holes, completely sleeved, bonded, curbed, flashed, and finished off in an approved manner, whether in concrete, steel grating, metal panels, or roofs.
 - d. Place non-shrinking grout or Dow Corning 3-6548 Silicone RTV or equivalent General Electric RTF 762 sealant as specified, in the following locations:
 - (1) All holes in concrete, walls, floor, and roof slabs after installation of conduit.
 - (2) All unused holes and sleeves as approved by Engineer.
 - e. Install wall entrance seals where conduit enters the building or vaults from exterior underground.
4. Install firestopping at all conduit penetration of fire-rated walls, ceilings, and floors. Firestopping system shall equal or exceed fire rating of wall, ceiling, or floor in which it is installed.
5. Install duct seal in conduits around cables at all conduit terminations at control panels and boxes containing terminations and splices.
6. Make connections to boxes, panels, and other equipment as follows:
 - a. Indoor Dry Locations: Double locknuts, one inside and one outside.
 - b. Outdoor and Damp Locations: Rigid weatherproof conduit hubs.
 - c. Bushings:
 - (1) Placed on end of conduit in addition to locknuts.
 - (2) Install with integral grounding connector and conductor where all conduits pass through multiple concentric panel knockouts and where the conduit must be bonded to equipment it is not attached to.
7. Running threads will not be permitted.
8. Coat all field cut threads in galvanized conduit with cold galvanizing paint.
9. Comply with applicable requirements of NEC pertaining to installation of conduit systems.
10. Place drainage fittings or weep holes at unavoidable low points where moisture can collect.
11. Install an entire conduit system that is electrically continuous with bonding jumpers provided as necessary to conform to NEC.
12. Install expansion fittings at all building expansion joints and every 100 feet of continuous conduit.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

- B. Rigid Galvanized Steel Conduit:
 - 1. Buried:
 - a. Install where indicated.
 - b. Install in as straight a run as possible between termination points of exact routing to be determined in the field and subject to approval by Engineer.
 - c. Bury conduits a minimum of 30 inches below finish grade unless indicated otherwise.
 - d. Slope conduit away from conduit risers where possible.
 - e. Maintain 6-inch separation from underground piping.
 - f. Use long radius elbows for all primary feeders unless indicated otherwise.
 - g. Use PVC jacketed rigid steel conduit risers where routed through concrete slabs.
 - h. After trench bottom has been finished to grade, lay conduit. Backfilling shall be as specified in DIVISION 31.
 - 2. Cap ends of all conduit risers before backfilling.
- C. Rigid Steel Conduit PVC Jacketed:
 - 1. Install where indicated.
 - 2. Coat field cut threads with manufacturer's standard product in accordance with manufacturer's recommendations.
 - 3. Use bender one size larger for conduit sized 1 inch or less and conventional bender for conduit sized above 1 inch.
 - 4. Use strap wrench to tighten conduit. Repair damaged coating with liquid patching compound recommended by conduit manufacturer.
 - 5. Exposed:
 - a. Install where indicated.
 - b. Group parallel runs in neatly aligned banks where possible with a minimum of 1-inch clearance between conduits.
 - c. Run conduit parallel or perpendicular to walls, ceiling, beams, and columns unless indicated otherwise.
 - d. Route to clear all doors, windows, access walls, and openings.
 - e. Maintain 6-inch clearance between conduit and coverings on all hot lines; steam, hot water, and similar pipes.
 - f. Do not exceed a distance of 8 feet between supports on horizontal or vertical runs.
 - g. Install horizontal runs as high above floor as possible, and in no case lower than 7 feet above floor, walkway, or platform in passage area.
 - 6. Buried:
 - a. Install in as straight a run as possible between termination points of exact routing to be determined in the field and subject to approval by Engineer.
 - b. Bury conduits a minimum of 30 inches below finish grade unless indicated otherwise.
 - c. Slope conduit away from conduit risers where possible.
 - d. Maintain 6-inch separation from underground piping.
 - e. Use long radius elbows for all primary feeders unless indicated otherwise.
 - f. Use for conduit risers where routed through concrete slabs.
 - g. After trench bottom has been finished to grade, lay conduit. Backfilling shall be as specified in DIVISION 31.
 - h. Cap ends of all conduit risers before backfilling.
- D. Rigid Aluminum Conduit:
 - 1. Use in interior exposed locations and above grade outdoors.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

2. Do not install underground or cast in concrete.
 3. Use anti-seize compound on conduit threads.
 4. Use bender one size larger than nominal up through 1 inch and conventional size bender for conduit over 1 inch in size.
 5. Exposed:
 - a. Install where indicated.
 - b. Group parallel runs in neatly aligned banks where possible with a minimum of 1-inch clearance between conduits.
 - c. Run conduit parallel or perpendicular to walls, ceiling, beams, and columns unless indicated otherwise.
 - d. Route to clear all doors, windows, access walls, and openings.
 - e. Maintain 6-inch clearance between conduit and coverings on all hot lines; steam, hot water, and similar pipes.
 - f. Do not exceed a distance of 8 feet between supports on horizontal or vertical runs.
 - g. Install horizontal runs as high above floor as possible, and in no case lower than 7 feet above floor, walkway, or platform in passage area.
 6. For short runs, the use of flat steel tapes is prohibited. Polyethylene fish tapes and round, flexible, speedometer-type steel cables are recommended.
- E. Rigid PVC Conduit:
1. Install where indicated.
 2. Make all joints watertight with cement compound furnished by the conduit manufacturer.
 3. Exposed:
 - a. Group parallel runs in neatly aligned banks where possible with a minimum of 1-inch clearance between conduits.
 - b. Run conduit parallel or perpendicular to walls, ceilings, beams, and columns unless indicated otherwise.
 - c. Route to clear all door, windows, access wells, and openings.
 - d. Maintain 6-inch clearance between conduit and coverings on all hot lines; steam, hot water, and the like.
 - e. On horizontal and vertical runs do not exceed a distance of 3 feet between supports for conduits sized 1 inch or less and 5 feet between supports for conduits greater than 1 inch.
 - f. Install horizontal runs as high as possible, and in no case lower than 7 feet above floor, walkway, or platform in passage area.
 4. Buried:
 - a. Install in as straight a run as possible between termination points of exact routing to be determined in the field and subject to approval by Engineer.
 - b. Bury conduits a minimum of 30 inches below finish grade unless indicated otherwise.
 - c. Slope conduit away from conduit risers where possible.
 - d. Maintain 6-inch separation from underground piping.
 - e. Use PVC-jacketed rigid steel elbows at all risers and at any bend greater than 45 degrees unless indicated otherwise.
 - f. Use long radius elbows for all primary feeders unless indicated otherwise.
 - g. All risers shall be PVC-jacketed rigid steel conduit.
 - h. After trench bottom has been finished to grade, lay conduit. Backfilling shall be as specified in DIVISION 31.
 - i. Cap ends of all conduit risers before backfilling.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

- F. Liquid-Tight Flexible Metal Conduit.
 - 1. Use between rigid conduit and motor terminal boxes except where conduit runs down from above and cannot be conveniently supported by a floor flange.
 - 2. Place between rigid conduit or conduit box and control device cases where direct connection is not desirable for reasons of equipment movement, vibration, or for ease of maintenance.
 - 3. Install at all points of connection to equipment mounted on supports to allow for expansion and contraction.
 - 4. Conform to NEC with installation of conductors.
 - 5. Install at locations where rigid conduit connections are impractical.
 - 6. Use minimum length consistent with manufacturer's standard lengths, the acceptable bending radius, and with required movement of equipment.
 - 7. Maximum length of 3 feet unless otherwise approved by Engineer.
 - 8. Install an external bonding jumper to conform to NEC on conduit sized 1-1/2 inches and larger.
- G. Conduit Fittings:
 - 1. Installations of special fittings are indicated.
 - 2. Use aluminum fittings for joining aluminum to steel conduit.
 - 3. Install as required.

3.03 BOXES AND FITTINGS:

- A. Install electrical boxes, bushings, locknuts, nipples, connectors, sealing hubs, and fittings as required, indicated, in accordance with applicable requirements of NEC and in accordance with recognized industry practices to fulfill Project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- D. Provide (oil-tight) knockout closures to cap unused knockout holes where blanks have been removed.
- E. Install electrical boxes in only those locations which ensure ready accessibility to enclosed electrical wiring.
- F. Do not install aluminum products in concrete.
- G. Position recessed outlet boxes accurately to allow for surface finish thickness.
- H. Set floor boxes level and flush with finish flooring material.
- I. Fasten electrical boxes firmly and rigidly to the surfaces to which attached, structural surfaces to which attached, or solidly embed them in concrete or masonry.
- J. Properly ground metallic electrical boxes in compliance with the NEC. Bond all non-isolated equipment grounding conductors to all electrical boxes.
- K. Subsequent to installation of boxes, protect boxes from construction debris and damage.
- L. Install special boxes as indicated of size required for conduits and cables entering and leaving box.

3.04 SUPPORTS:

- A. Construct with sufficient rigidity to hold all mounted equipment and material in permanent and neat alignment.
- B. Design to provide 1/4-inch space between equipment housings and walls or columns upon which they are mounted.
- C. Do not exceed load requirements in NEC and NEMA standards.

SECTION 26 05 33 – RACEWAYS, BOXES, SEALS, AND FITTINGS FOR ELECTRICAL SYSTEMS: continued

- D. For galvanized members after Power Tool Cleaning SSPC-SP11, paint all welds, field cuts, and damaged areas with organic zinc-rich primer at 3-mils dry film thickness.
 - 1. Ameron - 68HS.
 - 2. Carboline - Carbozinc 859.
 - 3. International - Interzinc 52 HS.
 - 4. Tnemec - Tnemezinc 90-97.
- E. For coated supports, paint all welds, field cuts, and damaged areas with manufacturer's recommended paint.
- F. Use stainless-steel or PVC-coated conduit straps to support PVC-coated rigid steel conduit. Use stainless-steel clamps for supporting PVC coated rigid steel conduit on stainless-steel supports.
- G. Use nonmagnetic conduit clamps to support nonmagnetic conduit.
- H. Stainless-steel clamps and hardware shall be used in all other locations.

3.05 CONCRETE BASES:

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) 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 3,000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in DIVISION 03 - Concrete.
- C. Anchor equipment to concrete base.
 - 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.

3.06 INGROUND PULL BOXES:

- A. Install a minimum of 6 inches of compacted granular material below pull box.
- B. Install top of pull box flush with finished grade.
- C. Bring conduit up from below box or for straight pulls make conduit penetration in boxes per manufacturer's recommendations.

3.07 UNDERGROUND PLASTIC LINE MARKER:

- A. Install underground traceable line marker 6 inches below grade above all conduits.

3.08 PAINTING:

- A. Touchup: 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 (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 26 05 33

SECTION 26 05 43 – UNDERGROUND DUCT BANKS AND HANDHOLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Complete underground duct systems consisting of banks of nonmetallic ducts encased in reinforced concrete, and precast concrete handholes.
 - 2. All necessary earth and rock excavation and backfill.
 - 3. Removal and disposal of all excess excavation material.

1.03 RELATED REQUIREMENTS:

- A. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- B. Earthwork: DIVISION 31.
- C. Concrete: DIVISION 03.

1.04 REFERENCE STANDARDS:

- A. American Concrete Institute (ACI):
 - 1. 318-14 – Building Code Requirements for Structural Concrete.
- B. American Society for Testing and Materials (ASTM):
 - 1. A48 – Standard Specification for Gray Iron Castings.
 - 2. C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 3. C858 – Standard Specification for Underground Precast Concrete Utility Structures.
 - 4. F512 – Standard Specification for Smooth Wall Polyvinyl Chloride (PVC) Conduit and Fittings for Underground Installation.
- C. Federal Specifications:
 - 1. W-C-1094A – Conduit and Conduit Fittings, Plastic, Rigid.
- D. National Electrical Manufacturer's Association (NEMA):
 - 1. TC-2 – Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - 2. TC 6 – PVC and ABS Plastic Utilities Duct for Underground Installation.
 - 3. TC 8 – Extra Strength PVC Plastic Utilities Duct for Underground Installation.
- E. Underwriters Laboratories, Inc. (UL):
 - 1. 651 – Schedules 40 and 80 Rigid PVC Conduit.
 - 2. 651A – Type EB and a Rigid PVC Conduit and HDPE Conduit.

1.05 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Product Data: Submit the following for each type of product specified and included as minimum:
 - 1. Data sheets for each product supplied.
- C. Shop Drawings: Provide the following as minimum:
 - 1. Submit shop drawings for fabrication and installation of pre-cast concrete structures and cast-in-place concrete structures including the following:
 - a. Steel reinforcement drawings.
 - b. Elevation showing openings, pulling irons, cable supports, sump, steps, covers, frames and other details.

SECTION 26 05 43 – UNDERGROUND DUCT BANKS AND HANDHOLES: continued

- D. Closeout Submittals: Final documentation shall include the following as minimum:
 - 1. Certified “As-Built”/“As-Installed” drawings.
 - 2. Copies of all approved Product Data.

1.06 QUALITY ASSURANCE:

- A. Manufacturer Qualifications:
 - 1. The manufacturer shall be by a company specializing in providing precast products and services normally associated with precast-concrete construction. Design of precast handholes shall be prepared by a professional engineer licensed in the state of Arkansas to conform to the procedures set forth in ACI 318 and applicable standards of this specification and of the size, shape, and details indicated or specified.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Ducts:
 - 1. Carlon.
 - 2. Certain-Teed.
 - 3. Cantex.
- B. Duct Spacers:
 - 1. Carlon
 - 2. CertainTeed.
 - 3. Formex.
- C. Concrete Inserts:
 - 1. Unistrut Corporation.
 - 2. B Line Systems, Inc.
- D. Precast Handholes:
 - 1. Barbour Concrete Co.
 - 2. Oldcastle Precast, Inc.
 - 3. Engineer approved equal.

2.02 DUCTS:

- A. Conduit Types for Concrete Encasement:
 - 1. Type EB:
 - a. Tested to Underwriters' Laboratories, Inc. (UL) Standard UL 651A.
 - b. Type EB35, Heavy Wall, Thickness conforming to NEMA TC-8 and ASTM F512.
- B. Rated for use with 90°C conductors.
- C. Provide with all necessary end bells, couplings, offset couplings, elbows, plugs, and other fittings.
- D. Sizes as indicated.
- E. Install PVC coated rigid galvanized steel elbows for all duct termination risers and all non-sweeping 90 degree bends.
- F. Provide prefabricated, interlocking type plastic duct spacers for duct spacing as indicated.

2.03 REINFORCING STEEL:

- A. Provide as specified in DIVISION 03.

2.04 CONCRETE:

- A. Provide as specified in DIVISION 03.

SECTION 26 05 43 – UNDERGROUND DUCT BANKS AND HANDHOLES: continued

- B. Provide with red pigment to indicate buried electrical duct bank.

2.05 PRECAST HANDHOLES:

- A. Precast concrete handholes with precast concrete base and top slab shall conform to ASTM C857 and C858, except as noted below:
 - 1. Concrete, reinforcing steel and formwork shall conform to applicable sections of DIVISION 3.
 - 2. Top Slab Superimposed Live Load: A-16 (HS20-44 per AASHTO).
 - 3. Equivalent Fluid Soil Density: 90 pcf.
 - 4. Unit Weight of Soil: 120 pcf.
 - 5. Net Allowable Soil Bearing Pressure: 1500 psf for the top 2 feet and 1000 psf below 2 feet.
 - 6. Required Dimensions:
 - a. Minimum dimensions shall conform to Drawings.
- B. Units shall be constructed monolithically or of assembled sections with tongue-and-groove joints.
- C. Concrete top cover shall be removable with recessed galvanized steel lifting inserts. Lifting inserts shall conform to ASTM C857.
- D. Provide a flush mounted 30-inch manhole frame and cover shall be cast in the center of the cover.
- E. Provide flush mounted plastic coated pulling irons in the walls located opposite of each set of duct openings.
- F. Provide duct terminators to accommodate ducts entering as indicated.
- G. Provide 8-inch sump hole through base slab.
- H. Provide galvanized cable rack supports in each wall.
- I. Provide submittal for precast reinforced concrete handholes prior to installation. The submittal shall be sealed by a professional engineer licensed in the state of Arkansas.

2.06 CASTINGS:

- A. Manhole Frames and Covers:
 - 1. ASTM A48, Class 30B. Cover shall be marked with "Electric."
 - 2. Watertight bolt-down type with drop handles.
 - 3. Machine-bearing surfaces to provide an even seating.
 - 4. Coat with coal-tar pitch varnish.

2.07 WARNING TAPE:

- A. Standard 4-mil 3 inch wide tape, red with black letters imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW" shall be provided.

2.08 "PULLING IN" ROPE:

- A. Nylon or nylon equivalent composite.
- B. Minimum average breaking strength: 2000 pounds.

PART 3 - EXECUTION

3.01 EXCAVATION AND TRENCHING FOR DUCT BANKS AND HANDHOLES

- A. Perform as specified in DIVISION 31.
- B. Work with extreme care near existing underground utilities to avoid damaging them.

SECTION 26 05 43 – UNDERGROUND DUCT BANKS AND HANDHOLES: continued

- C. Pitch the trench uniformly toward handholes or both ways from high points between handholes for required drainage.
- D. Notify the Owner's representative for inspection prior to any duct bank installation and prior to concrete placement.

3.02 INSTALLATION:

A. Duct Banks:

1. Ducts:

- a. Assemble as follows:
 - (1) On spacers to maintain horizontal and vertical separation indicated.
 - (2) With joints in adjacent ducts staggered.
 - (3) All joints watertight by application of joint sealer compound furnished by duct manufacturer.
 - (4) No reinforcing steel or other ferrous material between individual ducts.
 - b. Securely tie overall at 5 foot or closer intervals as required.
 - c. Secure to anchors after assembling to prevent flotation when placing concrete.
 - d. Slope towards handholes with a minimum continuous slope of 1/2 percent.
 - e. Align ducts for each 100 feet not greater than 4 inches horizontal.
 - f. All risers and non-sweeping bends shall be PVC coated rigid galvanized steel as specified.
 - g. Install end bells flush with face of concrete at each handhole and termination point unless indicated otherwise.
 - h. Immediately after cleaning, install a "pulling in" rope in each duct, and plug each end of all ducts.
2. Install warning tape along the entire length of duct banks at a minimum depth of 12 inches below grade or as indicated on drawings.
3. Reinforcing: Place as specified in DIVISION 03.
4. Concrete:
- a. Do not place prior to inspection and approval of duct and reinforcing installation by Engineer.
 - b. Place as specified in DIVISION 03.

B. Precast Handholes:

- 1. Install a minimum of 6 inches of compacted granular material on undisturbed soil below handhole.
- 2. Place at location and alignment as indicated.
- 3. Top slab and handhole shall be set flush with finished grade.
- 4. Install conduits as indicated.

C. Duct and Conduit Sealing:

- 1. Seal the ducts and conduits at building entrances and at outdoor equipment with a suitable non-hardening compound to prevent the entrance of moisture and gases.

3.03 BACKFILLING:

- A. Provide backfill and compaction as specified in DIVISION 31.

3.04 ADJUSTING AND CLEANING:

- A. Rod and clean all ducts with suitable cleaners, swabs and mandrels after completion of the duct bank.

END OF SECTION 26 05 43

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section specifies electrical identification work including the following:
 1. Buried cable and duct bank warnings.
 2. Electrical power, control, communication conductors and raceways.
 3. Operational instructions and warnings.
 4. Danger, caution and warning signs.
 5. Arc flash labels.
 6. Equipment/system identification nameplates.

1.03 REFERENCE STANDARDS:

- A. Applicable Standards: Comply with the applicable requirements of the following standards.
 1. American National Standards Institute (ANSI):
 - a. Z535.1-2006 – Safety Color Code for Marking Physical Hazards.
 - b. Z535.4-2011 – Product Safety Signs and Labels.
 2. Federal Specifications (FS):
 - a. FS L-P-387 – Polyethylene Low and Medium Density - Molding Material (for designation plates).
 3. National Fire Protection Association (NFPA):
 - a. 70 – National Electrical Code (NEC), as applicable to installation of identifying labels and markers for wiring and equipment.
 - b. 70E-2012 – Electrical Safety in the Workplace.
 - c. 72 – National Electric Safety Code (NESC) – IEEE C2.
 4. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.144 – Safety Color Code for Marking Physical Hazards.
 - b. 29 CFR 1910.145 – Specifications for Accident Prevention Signs and Tags.
 5. Underwriters Laboratories (UL), pertaining to electrical identification systems:
 - a. 969-2010 – Standards for Marking and Labeling Systems.

1.04 SUBMITTALS:

- A. Refer to DIVISION 01 and Section 26 05 10 - General Electrical Requirements for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 1. Product Data: Submit manufacturer's data on electrical identification materials and products.
 2. Samples: Submit samples of each color, lettering style, and other graphic representation required for each identification material or system.

1.05 QUALITY ASSURANCE:

- A. Comply with IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION: continued

- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.06 COORDINATION:

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, and standards. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):
 - 1. Brady Worldwide, Inc.
 - 2. Panduit Corp.
 - 3. Seton Identification Products.
 - 4. Thomas & Betts Corp.

2.02 ELECTRICAL IDENTIFICATION MATERIALS:

- A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option; but provide single selection for each application.
- B. Self-Adhesive Plastic Signs:
 - 1. General: Self-adhesive or pressure-sensitive, preprinted, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., "DANGER."
 - a. Colors: Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.
 - 2. Arc Flash Labels:
 - a. Shall not be smaller than 4"H x 6"W in size.
 - b. The header shall read "DANGER".
 - c. The labels shall be printed with equipment designation, arc flash warnings, and the required personnel protective equipment (PPE) requirements.
 - d. Shall be printed in English.
 - e. The colors shall be black/red on white.
 - 3. Source of Supply Labels:
 - a. Label shall read "Source of Supply" on the first line with the applicable equipment designation on the second line.
 - b. Minimum character height shall be 1/2".
 - c. The color shall be black on white.

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION: continued

- C. Underground Plastic Line Marker:
 - 1. Permanent, traceable, bright-colored, continuous-printed plastic tape marker, intended for marking below grade utilities. Shall not be less than 6 inches wide by 4 mils thick.
 - 2. Provide tape marker with printing which most accurately indicates type of utility such as "Fiber Optic Cable Below" or "Electric Below."
 - 3. Provide with continuous metal strip or core to allow nonmetallic conduits or fiber optic cables to be located.
 - 4. Manufactured by Brady or Engineer-approved equal.
- D. Wire/Cable Identification:
 - 1. Designed to provide a permanent wire and cable identification system.
 - 2. Show complete cable number. Cable numbers are defined in the Cable Schedule and/or Contract Drawings.
 - 3. Cable numbers shall be, stamped, or typed.
 - 4. Character size for cable numbers shall be a minimum of 1/8 inch.
 - 5. Material shall be nonmetallic and impervious to moisture.
 - 6. Be securely attached to cables and accessible for inspection.
 - 7. Cable identification tags, marking and attachment methods shall be subject to approval of Engineer.
- E. Self-Adhesive Plastic Signs:
 - 1. General: Self-adhesive or pressure-sensitive, preprinted, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., "TRANSFER PUMP"
 - a. Colors: Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.
- F. Baked Enamel "Danger" Signs:
 - 1. "DANGER" signs of baked enamel finish on 20-gauge steel (unless specified otherwise); of standard safety red, safety black, and safety white as defined by ANSI Z535.1; 14 inches by 10 inches size, except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., "____ VOLTS, KEEP AWAY." Sign shall conform to OSHA and ANSI Z535.1.
- G. Baked Enamel "Caution" Signs:
 - 1. "CAUTION" signs of baked enamel finish on 20 gauge steel (unless specified otherwise); of standard safety yellow with safety black letters; 14 inches by 10 inches size, except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., "Caution for Ear Protection Required in this Area."
- H. Based Enamel "WARNING" Signs:
 - 1. "WARNING" signs of baked enamel finish on 20 gauge steel (unless specified otherwise); of standard safety orange with safety black letters; 14 inches by 10 inches size, except where 10 inches by 7 inches is largest size that can be applied where needed and except where larger size is needed for adequate vision; with recognized standard explanation wording. Sign shall conform to OSHA and ANSI Z535.1.
- I. Engraved Plastic-Laminate Nameplates:
 - 1. General: Engraving stock melamine plastic laminate nameplates, in sizes and thicknesses specified or indicated.
 - 2. Black face and white core plies (white letter color) except as otherwise indicated, specified or required.
 - 3. Engraved with engraver's standard letter style of sizes and wording indicated,

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION: continued

4. Bevel edges to expose black core on perimeter.
5. Colors shall comply with OSHA and ANSI Z535.1. Nameplate shall be punched for mechanical fastening except where adhesive mounting is necessary because of surface it is mounted or the enclosure protection ratings will be compromised.
 - a. Thickness: 1/16-inch nominal, for units up to 20 square inches or 8 inch length; 1/8-inch for larger units.
 - b. Fasteners: Self-tapping stainless steel screws or industrial grade double-faced tape when required to maintain enclosure ratings.
6. Lettering and Graphics:
 - a. Coordinate names, abbreviations, and other designations used in electric identification work with corresponding designations shown, specified, or scheduled on the Contract Drawings.
 - b. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment.
 - c. Minimum sizes for letters and numbers shall be as required for the intended service.
 - d. Comply with OSHA requirements. Comply with requirements of ANSI Z535.1.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION:

- A. General Installation Requirements:
 1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.
 2. Coordination: Where identification is to be applied to surfaces which require finish painting, install identification after completion of painting.
 3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.
 4. Provide and install arc flash labels on equipment and enclosures as specified.
 5. Provide and install source of supply labels on all panels supplied by feeder circuits as required by the NEC.
- B. Underground Cable, Conduit, and Duct Bank Identification Marker:
 1. General: During back-filling/top-soiling of each exterior underground direct buried electrical, signal or communication cable, conduit and duct bank, install continuous underground plastic line marker, located directly over the direct buried cable, conduit or duct bank at 12 inches below finished grade. Where multiple small direct buried cables are buried in a common trench and do not exceed an overall width of 16 inches, install a single line marker.
 2. Install line marker for every cable below grade, regardless of whether direct-buried, protected in conduit, or conduit in duct bank.
- C. Wire/Cable Identification Bands:
 1. General: Apply cable/conductor identification bands, including circuit number, on each wire/cable in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION: continued

- D. Operational Identification and Warning Plasticized Tags and Metal Signs and Plastic Signs:
 - 1. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install signs with instruction or warnings. When signs are installed on switches, outlets, controls, devices and covers of electrical enclosures they may be self-adhesive vinyl or plastic. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.
- E. Danger Signs:
 - 1. General: In addition to installation of danger signs specified, indicated, and required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about Project.
 - 2. XXX Volts: Install danger signs (with actual circuit voltage identified) on all building doors, panelboards switches, circuit breakers, etc., wherever it is possible (under any circumstances) for persons to come into contact with electrical voltages to ground greater than 277V.
 - 3. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons or damage to or loss of property.
- F. Equipment/System Identification Nameplates:
 - 1. General: Install engraved plastic-laminated nameplates on each major unit of electrical equipment in the building.
 - 2. Nameplates shall include unit designation, normal source, circuit voltage, and other data specifically indicated.
 - 3. Provide nameplates for each unit of the following categories of electrical work:
 - a. Panelboards, electrical cabinets, and other electrical equipment enclosures.
 - b. Individual motor starters.
 - c. Disconnect switches.
 - d. Push buttons, selector switches, indicating lights.
 - e. Lighting control equipment and contactors.
 - f. Transformers.
 - g. Instruments.
 - 4. Install markers, tags, nameplates, and signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure the identification with fasteners, except use adhesive material where fasteners should not or cannot penetrate surface.

END OF SECTION 26 05 53

SECTION 26 22 00 – LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section specifies transformer work as indicated by drawings and schedules.
- B. Types of transformers specified in this Section include the following:
 - 1. Dry-type transformers.

1.03 RELATED REQUIREMENTS:

- A. SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS for grounding.

1.04 REFERENCE STANDARDS:

- A. American National Standards Institute (ANSI):
 - 1. C2 – National Electrical Safety Code.
 - 2. C57.12.01 – General Requirements for Dry-Type Distribution and Power Transformers.
 - 3. C57.12.50 – Requirements for Ventilated Dry-Type Distribution Transformers 1 500 kVA, Single-Phase, and 15-500 kVA, Three-Phase with High-Voltage 601 34,500V, Low Voltage 120-600V.
 - 4. C57.12.91 – Test Code for Dry-Type Distribution and Power Transformers.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. TP1 – Guide to Determining Energy Efficiency for Distribution Transformers.
 - 2. TP2 – Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
 - 3. TR1 – Transformers, Regulators, and Reactors. (Supplements ANSI C57 - Series Standards.)
 - 4. TR27 – Commercial, Institutional, and Industrial Dry-Type Transformers.
 - 5. ST20 – Dry-type Transformers for General Applications.
 - 6. 250 – Enclosures for Electrical Equipment.
- C. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC). Comply with NEC as applicable to installation and construction of electrical power/distribution transformers.
- D. Underwriters Laboratories (UL): Comply with applicable requirements of ANSI/UL 506 Safety Standard for Specialty Transformers. Provide transformers and components which are UL-listed and labeled.

1.05 SUBMITTALS:

- A. Submit as specified in DIVISION 01 and SECTION 26 05 10 - GENERAL ELECTRICAL REQUIREMENTS.
- B. Product Data: Submit for each type of product specified and included, with the following as minimum:
 - 1. Technical product data: Includes, but not limited to, rated kVA, frequency, primary and secondary voltages, wiring diagram, percent taps, polarity, impedance and certification of transformer performance efficiency at 100% load, percentage voltage regulation at 100% load at 75°C, full-load losses in watts, percent impedance at 75°C, hot-spot and average

SECTION 26 22 00 – LOW-VOLTAGE DISTRIBUTION TRANSFORMERS: CONTINUED

temperature rise above 40°C ambient temperature, sound level in decibels, and standard published data.

- C. Shop Drawings: Provide the following as minimum:
 - 1. Submit manufacturer's drawings indicating dimensions and weight loadings for transformers and wall brackets.
 - 2. Submit transformer nameplate data.
 - 3. Wiring Diagrams: Submit wiring diagrams for transformers. Clearly differentiate between portions of wiring that are manufacturer factory installed and portions to be field-installed.
- D. Submit all field test data.
- E. Closeout Submittals: Final documentation shall include the following as minimum:
 - 1. Operation and Maintenance Manuals including the following:
 - a. Operation and maintenance manuals for all components furnished.
 - b. Certified "As-Built" drawings of all equipment with information listed above.
 - c. Copies of all approved Product Data.
 - d. Copies of all approved Test Reports.
 - e. Warranty Information.

1.06 QUALITY ASSURANCE:

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Transformers shall be stored according to the manufacturer's instructions and in a conditioned space to avoid condensation, dust, and other environmental contaminants.
- B. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- C. Handle and prepare transformers for installation according to NEMA ST 20.

1.08 PROJECT SITE CONDITIONS:

- A. Environmental Limitations:
 - 1. Do not deliver or install transformers until spaces are enclosed and weather tight, any wet work is complete and dry, work above transformers is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
- B. Service Conditions: NEMA ST 20, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 3,300 feet.

SECTION 26 22 00 – LOW-VOLTAGE DISTRIBUTION TRANSFORMERS: CONTINUED

1.09 COORDINATION:

- A. Coordinate layout and installation of transformers 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 panels.

1.10 WARRANTY:

- A. All equipment furnished under this section shall be warranted by the contractor and the equipment manufacturer(s) for a minimum period of one year after substantial completion.
- B. Warranty shall include all parts, labor, and expenses to perform necessary work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Siemens.
 - 4. Square D, Schneider Electric.

2.02 TRANSFORMERS:

- A. General:
 - 1. Except as otherwise specified or indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation.
 - 2. Comply with NEMA TP 1, Class 1 efficiency levels for all transformers 15 kVA and larger.
 - 3. Core material shall be grain-oriented, non-aging silicon steel. Coils shall be continuous windings without splices except for taps. Internal coil connections shall be brazed or pressure type.
- B. Dry-Type Transformers (45 kVA or less):
 - 1. Factory-assembled and -tested, general-purpose, air-cooled, dry-type transformers; of sizes, characteristics, and rated capacities indicated.
 - 2. Three-phase transformer:
 - a. 480V delta connected primary and 208/120V wye connected secondary with grounded neutral, 60-hertz, 30-kV BIL.
 - b. Manufacturer's standard impedance, with Aluminum primary and secondary windings.
 - c. Provide primary winding with 4 full capacity taps; two 2 1/2% increments below and above full-rated voltage for de-energized tap-changing operation.
 - d. Insulate with 220°C, UL-component-recognized insulation system with a maximum of 115°C rise above 40°C ambient temperature.
 - e. Rate transformer for continuous operation at rated kVA.
 - f. Limit transformer surface temperature rise to maximum of 65°C.
 - g. Provide terminal enclosure, with cover, to accommodate primary and secondary winding connections and raceway connectors.
 - h. Equip terminal leads with connectors installed. Limit terminal compartment temperature to 75°C when transformer is operating continuously at rated load with

SECTION 26 22 00 – LOW-VOLTAGE DISTRIBUTION TRANSFORMERS: CONTINUED

ambient temperature of 40°C. Provide wiring connectors suitable for copper wiring.

- i. Cushion-mount transformers with external vibration isolation supports
- j. Sound-level ratings shall not exceed ANSI/NEMA standards. Conform to NEMA ST20.
- k. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap.
- l. Provide transformers with ventilated or fully enclosed sheet steel enclosures.
- m. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure.
- n. All transformers shall be suitable for floor mounting unless noted otherwise. Provide wall mounting brackets for wall or column mounted transformers.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NESC, NEMA, ANSI and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements. Arrange equipment to provide adequate space for access and for cooling air circulation.
- B. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
- C. Mount transformer on wall or floor at location indicated. Level and plumb as required. Mount with necessary brackets fabricated by transformer manufacturer.

3.03 CONNECTIONS:

- A. Provide equipment grounding connections for transformers as specified, indicated, and as required. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounding. Provide grounding in accordance with SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

3.04 IDENTIFICATION:

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS.

SECTION 26 22 00 – LOW-VOLTAGE DISTRIBUTION TRANSFORMERS: CONTINUED

- B. Nameplates: Label each transformer with a nameplate complying with requirements for identification specified in SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.05 FIELD QUALITY CONTROL:

A. Tests and Inspections:

1. Prior to energization of transformers, check all accessible connections for compliance with manufacturer's torque tightening specifications. Clean out any dust and dirt.
2. Prior to energization, check circuitry for electrical continuity and for short circuits.
3. Perform insulation resistance test: Megger between high-voltage winding to low-voltage winding, low-voltage winding to ground, and high-voltage winding to ground. Record and submit test results. If readings are below 50 megohms (at 77°F), notify Engineer before energizing transformer.
4. Perform transformer turns ratio test (TTR) on the full winding and all taps. Record and submit test results.
5. Upon completion of installation of transformers and testing, energize primary circuitry at rated voltage and frequency from normal power source, and test transformers, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site then retest to demonstrate compliance; otherwise, remove and replace with new units or components and proceed with retesting.
6. Adjust transformer primary taps for nominal system voltage at initial installation and again when the transformer reaches its designed "full" load condition after occupancy by the Owner. Schedule all required electrical outages with the Owner.
7. Prepare test and inspection reports, including a certified report that identifies transformers included and testing results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 FINISHES:

- A. Equipment coatings shall be free from scratches, rust, or other defects.
- B. All damaged or defective coatings shall be repaired prior to final acceptance.
- C. Field Painting:
 1. Touch Up:
 - a. Contractor shall prepare surfaces and touch up manufacturer applied coatings as required for any damage during shipment and installation.
 - b. Field painting shall be performed based on manufacturer's recommended procedures.
 - c. Transformer manufacturer shall furnish Contractor with an adequate quantity of touch-up paint to match the factory applied finish.

3.07 ADJUSTING AND CLEANING:

- A. Upon completion of installation, clean interior and exterior of transformers. Remove paint splatters, spots, dirt and debris.

3.08 PROTECTION:

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until unit is placed into service.

END OF SECTION 26 22 00

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section specifies panelboards including cabinets and boxes, as indicated by drawings and schedules, and as specified herein.
- B. Types of panelboards and enclosures required for the project include the following:
 - 1. Power and Lighting branch circuit panelboards.

1.03 RELATED REQUIREMENTS:

- A. Wires/cables, electrical boxes, fittings, and raceways required in conjunction with the installation of panelboards and enclosures: Other DIVISION 26 Sections.
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding.
- C. Section 26 05 53 – Identification for Electrical Systems for electrical identification.

1.04 REFERENCE STANDARDS:

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):
 - 1. C62.41.1-2002 – Surge Environment in Low-Voltage (1000V and less) AC Power Circuits.
 - 2. C62.41.2-2002 – Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
 - 3. C62.45-2002 – Surge Testing on Equipment Connected to Low Voltage (1000V and less) AC Power Circuits.
 - 4. C62.62-2000 – Test Specification for Surge Protective Devices for Low Voltage AC Power Circuitry.
 - 5. Std 1100-2005 (Emerald Book) – Recommended Practice for Powering and Grounding Electronic Equipment.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. 250 – Enclosures for Electrical Equipment (1,000V Maximum).
 - 2. PB1 – Panelboards.
 - 3. PB1.1 – Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600V or Less.
 - 4. PB2.2 – Application Guide for Ground-Fault Protective Devices for Equipment.
- C. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC): Comply with applicable local code requirements of the authority having jurisdiction and NEC as applicable to installation and construction of electrical panelboards and enclosures.
- D. Underwriters Laboratories (UL): Provide panelboard units which are UL listed and labeled.
 - 1. 50 – Electrical Cabinets and Boxes.
 - 2. 67 – Electrical Panelboards.
 - 3. 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 4. 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - 5. 869A – Service Equipment.
 - 6. 1053 – Ground-Fault sensing and Relaying Equipment.
 - 7. 1283 – Electromagnetic Interference Filters.

SECTION 26 24 16 – PANELBOARDS: CONTINUED

8. 1449 3rd Edition, 2009 – Safety for Surge Protective Devices.
 9. Special Use Markings: Provide panelboards constructed for special use with appropriate UL markings which indicate that they are "Suitable for Use as Service Equipment."
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01 and SECTION 26 05 10 - GENERAL ELECTRICAL REQUIREMENTS.
 - B. Submittals shall be custom prepared by the panelboard manufacturer for this specific application.
 - C. Product Data: Submit for each type of product specified and included, with the following as minimum:
 1. Data sheets for all components furnished as part of the system package.
 - D. Shop Drawings: Provide the following as minimum:
 1. Panelboards:
 - a. Panelboard dimensions and weight.
 - b. Complete data on circuit breakers. Submit time - current characteristic curves of all devices.
 - c. Panelboard short-circuit interrupting capacity, and information on buses: phase, neutral, and ground.
 - d. Information on whether panelboard is fed from top or bottom.
 - e. Data on maximum and minimum incoming and outgoing feeder and branch circuit wire size.
 - f. Data on door, locks, and mounting: surface or flush.
 - g. Data on total number of poles and number of unused poles available for future use.
 2. Surge Protection Devices:
 - a. Power input voltage and frequency.
 - b. UL 1449 Listing documentation - or other Nationally Recognized Testing Laboratory (NRTL) - verifying the following:
 - (1) Short Circuit Current Rating (SCCR).
 - (2) Voltage Protection Ratings (VPRs) for all modes.
 - (3) Maximum Continuous Operating Voltage rate (MCOV).
 - (4) I-nominal rating (I-n).
 - (5) Device type designation.
 - c. Response Time.
 - d. Peak surge current rating per phase.
 - e. Warranty.
 - E. Closeout Submittals: Final documentation shall include the following as minimum:
 1. Operation and Maintenance Manuals including the following:
 - a. Operation and maintenance manuals for all components furnished.
 - b. Certified "As-Built" drawings of all equipment with information listed above.
 - c. Copies of all approved Product Data.
 - d. Copies of all approved Test Reports.
 - e. Warranty Information.
 - F. Maintenance Material Submittals:
 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 2. Keys: Two spares for each type of panelboard cabinet lock.

SECTION 26 24 16 – PANELBOARDS: CONTINUED

1.06 QUALITY ASSURANCE:

- A. Materials and Equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least one year prior to Bid opening.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, surge protective devices, components, and accessories from single source from single manufacturer.
- C. 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Panelboards shall be stored according to the manufacturer's instructions and in a conditioned space to avoid condensation, dust, and other environmental contaminants.
- B. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating to prevent condensation.
- C. Handle and prepare panelboards for installation according to NEMA PB 1.

1.08 PROJECT SITE CONDITIONS:

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, any wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6,600 feet.

1.09 COORDINATION:

- A. 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.

1.10 WARRANTY:

- A. All equipment furnished under this section shall be warranted by the contractor and the equipment manufacturer(s) for a minimum period of one year after substantial completion.
- B. Warranty shall include all parts, labor, and expenses to perform necessary work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Eaton.
- B. General Electric Company.
- C. Siemens.
- D. Square D, Schneider Electric.

SECTION 26 24 16 – PANELBOARDS: CONTINUED

2.02 GENERAL REQUIREMENTS FOR PANELBOARDS:

- A. Except as otherwise indicated, provide panelboards, enclosures, and ancillary components of types, size, and ratings indicated, which comply with manufacturer's standard materials and with the design and construction in accordance with published product information.
- B. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated.
- C. Equip with proper number of panelboard switching and protective devices as required for complete installation.
- D. Provide ground fault circuit interrupter type circuit breakers where indicated.
- E. Enclosures: Flush- and surface-mounted cabinets as indicated.
 - 1. Provide enclosures fabricated by same manufacturer as panelboards which mate and match properly with panelboards.
 - 2. Rated for environmental conditions at installed location. Provide NEMA type as described below, unless indicated or specified otherwise.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 3. Materials: Galvanized sheet steel cabinet type enclosures, in sizes required. Provide code gage (minimum 16-gage) thickness steel.
 - 4. Front: Secured to box with adjustable, concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 5. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Front doors shall have flush locks with two keys per panelboard, all panelboard enclosures keyed alike.
 - 6. Finishes:
 - a. Color: Baked gray enamel finish over a rust inhibitor coating.
 - b. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - c. Back Boxes: Galvanized steel.
 - 7. Directory Card: Inside panelboard door, equip with interior circuit directory frame and removable card with clear plastic covering.
- F. Phase, Neutral, and Ground Buses:
 - 1. Bus shall be braced to withstand available short circuit currents as indicated.
 - 2. Provide suitable lugs on neutral bus for incoming and outgoing feeders requiring neutral connections.
 - 3. Equipment Ground Bus: Bare, uninsulated, adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Material: Tin-plated aluminum.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Provide terminals UL rated for 75°C (Minimum) conductors.

2.03 PANELBOARDS:

- A. Panelboards: NEMA PB 1, dead front, 480Y/277V and 208Y/120V, 3 phase, 4 wire, 60 hertz with full-sized neutral bus.
- B. Branch-circuit type as indicated with switching and protective devices in quantities, ratings, types, and arrangements shown.
- C. Incoming Mains Location: Top or Bottom as required.

SECTION 26 24 16 – PANELBOARDS: CONTINUED

- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices:
 - 1. Bolt-on, molded-case circuit breakers.
 - 2. Molded-case circuit breakers shall have toggle handles that indicate when tripped.
 - 3. Where multiple pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously.
 - 4. Circuit breakers shall be replaceable without disturbing adjacent units.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Integral surge protection device as specified this section.
- H. Main panelboards rated 480Y/277V shall be service entrance rated.

2.04 PANELBOARD INTEGRAL SURGE PROTECTION DEVICE:

- A. Provide surge protection device (SPD) designed for installation within the panelboard. The SPD shall connect directly to the bus bar and have an integral disconnect. SPD shall be approved by panelboard manufacturer for installation within the panelboard. Indicating lights shall be mounted in the face of the panelboard. The unit shall provide the following modes of protection: line-to-line (L-L), line-to-ground (L-G), line-to-neutral (L-N), and neutral to ground (N-G).
- B. SPDs shall have the following characteristics:
 - 1. UL 1449 Third Edition listed and labeled.
 - 2. Shall be of a parallel design using fast-acting transient energy protection that will divert and dissipate the surge energy.
 - 3. Shall use metal oxide varistor technology. (Spark gaps, gas tubes, selenium cells and SCRs shall not be acceptable.)
 - 4. Shall include internal fuses and thermally protection over every suppression component of every mode, including N-G for wye configurations..
 - 5. Shall be factory-installed by the panelboard manufacturer via a direct bus bar connection immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 - 6. The panelboard shall be capable of re-energizing upon removal of the SPD.
 - 7. Shall have integral, panel-front status monitors or remote status panel ability as a minimum to indicate a continuous positive status of all protected modes. Diagnostics shall be electrically isolated to prevent damage by surges.
 - 8. The maximum continuous operating voltage at 60 Hz shall be capable of sustaining at least 115% of the peak voltages continuously without degrading.
 - 9. The maximum UL 1449 Third Edition Voltage Protection Ratings (VPR) for the device must not exceed the following:

| Service | L-N | L-G | N-G | L-L | MCOV |
|----------------------------------|-------|-------|-------|-------|----------|
| 120/240Vac, 3-Wire + Gnd | 700V | 700V | 700V | 1200V | 150V |
| 208/120Vac, 3-phase, 4-wire | 700V | 700V | 700V | 1200V | 150/276V |
| 480 Vac 3-phase, 3-wire Delta | NA | 1800V | NA | 1800V | 550V |
| 480/277 Vac, 3-phase, 4-wire | 1200V | 1200V | 1200V | 2000V | 550/320V |

SECTION 26 24 16 – PANELBOARDS: CONTINUED

10. Shall be UL labeled with 20kA I-n for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
 11. Shall be UL labeled as a Type 1 or Type 2 device and shall not require external or supplemental overcurrent safety controls to meet UL 1449 3rd Edition.
 12. Warranty: SPD manufacturer shall provide free replacement of the entire model with a minimum warranty period of 10 years from date of shipment. This warranty shall be limited only by failure to comply with manufacturer's installation instructions and applicable national or local code and may not exclude lightning or temporary overvoltage (TOV).
- C. Service Entrance and Distribution Panelboard Surge Protection Device:
1. The SPD unit shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C3 environments.
 2. The SPD shall be suitable for 480/277V 3-phase, 4-wire, 60 Hz.
 3. Shall have a minimum peak surge current of 150kA per phase.
 4. Shall include EMI/RFI filtering (sometimes called sine-wave tracking filtering technology) for ring wave suppression.
 5. Shall have a minimum EMI/RFI filtering of -50dB at 100 kHz.
 6. UL 1283 Listed. (Latest Edition)
 7. Filters in the N-G mode shall not be allowed.
- D. Accessories:
1. Green LED status indicator per phase.
 2. Red LED service indicator.
 3. Test function for LEDs and audible alarm.
 4. Internal audible alarm with mute switch.
 5. Surge event counter.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Verify site conditions are suitable for installation of equipment.
- 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.

3.02 INSTALLATION:

- A. Install panelboards and enclosures as indicated, providing NEC required working space, in accordance with manufacturer's written instructions, applicable requirements of NEC and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
- C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
- D. Provide properly wired electrical connections for panelboards within enclosures.

SECTION 26 24 16 – PANELBOARDS: CONTINUED

- E. Install numbers on all circuit breakers, and type the panelboard's circuit directory card upon completion of installation work. Clearly identify the load on each circuit and the circuit number according to the Contract Drawings.
 - F. Provide filler plates in all unused spaces.
- 3.03 GROUNDING:
- A. Provide equipment grounding connections for panelboard enclosures as indicated and as required by NEC. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds. Provide grounding as specified in SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- 3.04 IDENTIFICATION:
- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS.
 - B. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- 3.05 FIELD QUALITY CONTROL:
- A. Perform tests and inspections.
 - B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
 - C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.
 - 3. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.
 - 4. Prior to energization, check panelboard circuits for short circuits, electrical continuity of circuits, enclosure grounding and neutral grounding at service entrance and at incoming derived source transformer.
 - 5. Prior to energization of panelboards, check with insulation resistance tester: phase-to-phase and phase-to-ground insulation resistance levels of each phase bus to ensure requirements are fulfilled. Record and submit test results.
 - 6. Panelboards will be considered defective if they do not pass tests and inspections.
 - 7. Prepare test and inspection reports, including a certified report that identifies panelboards included and testing results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.06 FINISHES:
- A. Equipment coatings shall be free from scratches, rust, or other defects.
 - B. All damaged or defective coatings shall be repaired prior to final acceptance.
 - C. Field Painting:
 - 1. Touch Up:

SECTION 26 24 16 – PANELBOARDS: CONTINUED

- a. Contractor shall prepare surfaces and touch up manufacturer applied coatings as required for any damage during shipment and installation.
- b. Field painting shall be performed based on manufacturer's recommended procedures.
- c. Panelboard manufacturer shall furnish Contractor with an adequate quantity of touch-up paint to match the factory applied finish.

3.07 ADJUSTING AND CLEANING:

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Upon completion of installation, clean interior and exterior of panelboards. Remove paint splatters, spots, dirt and debris.

3.08 PROTECTION:

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.09 DEMONSTRATION:

- A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 26 24 16

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this SECTION.
- 1.02 SUMMARY:
- A. This SECTION covers wiring devices for lighting and utilization equipment including but not limited to the following:
 1. Receptacles.
 2. Switches.
 3. Wall Plates.
- 1.03 RELATED REQUIREMENTS:
- A. SECTION 26 05 26 – Grounding and Bonding for Electrical Systems.
 - B. SECTION 26 05 33 – Raceways, Boxes, and Supports for Electrical Systems.
- 1.04 REFERENCE STANDARDS:
- A. National Electrical Manufacturers Association (NEMA):
 1. FB 11 – Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
 2. WD 1 – General Color Requirements for Wiring Devices.
 3. WD 6 – Wiring Devices - Dimensional Specifications.
 4. 410 – Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
 - B. National Fire Protection Association (NFPA):
 1. 70 – National Electrical Code (NEC).
 - C. Underwriters Laboratories (UL):
 1. 20 – General-Use Snap Switches.
 2. 498 – Attachment Plugs and Receptacles.
 3. 943 – Ground-Fault Circuit-Interrupters.
 4. 486A-486B – Wire Connectors.
 - D. Federal Specification (Fed. Spec.):
 1. W-C-596 – Electrical Power Connectors.
 2. W-S-896 – Switches, Toggles (Toggle and Lock), Flush Mounted.
- 1.05 SUBMITTALS:
- A. Product Data for each product specified.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Appleton, Emerson Electric Co.
 - B. Cooper, Crouse-Hinds, Division of Eaton.
 - C. Hubbell, Inc.
 - D. Leviton Manufacturing Co., Inc.
 - E. Pass & Seymour, Legrand North America, Inc.
 - F. Russellstoll, Thomas & Betts.
 - G. Woodhead, Molex.

SECTION 26 27 26 – WIRING DEVICES: continued

2.02 RECEPTACLES:

- A. General:
 - 1. All receptacles and associated materials shall bear the appropriate UL label.
 - 2. Provide all necessary wiring and accessories as required for complete installation.
- B. Flush-Mounted and Surface-Mounted Receptacles:
 - 1. Rated 20A at 125Vac.
 - 2. Duplex, arc-resistant, back and side wired, 3-wire grounding type (NEMA Reference 5-20R).
 - 3. Receptacle and wall plates shall be as follows:
 - a. Flush-mounted receptacles in all areas shall be gray with 302 stainless steel wall plates.
 - b. Surface-mounted receptacles shall be gray and have cast copper-free aluminum FS or FD single or multiple gang boxes with matching cast aluminum 302 stainless steel cover plate.
 - 4. "Specification" grade type 5362, Fed. Spec. W-C-596 compliant.
 - 5. Locations as indicated.
 - 6. When indicated provide GFCI type as specified in this SECTION.
- C. Ground Fault Circuit Interrupter (GFCI) Receptacles:
 - 1. Flush or surface mounted as indicated.
 - 2. Rated 20A at 125Vac, Fed. Spec. W-C-596.
 - 3. Back and side wired terminals with feed-through design.
 - a. Terminal installation unless indicated otherwise.
 - 4. UL Standard 943 Class A, Group 1.
 - 5. Leakage current sensitivity: 5 mA \pm 1 mA.
 - a. Opens circuit within 25 milliseconds of reaching 5 mA.
 - 6. Duplex, arc resistant and pre wired.
 - 7. Cover plate materials and colors shall match standard receptacles as specified this SECTION.
 - 8. FD box.
 - 9. Locations as indicated.
- D. Weatherproof Receptacles:
 - 1. Flush or surface mounted as indicated.
 - 2. Rated 20A at 125Vac, Fed. Spec. W-C-596.
 - 3. GFCI receptacle as specified in this SECTION when indicated.
 - 4. Provide a gray receptacle with a cast aluminum weather-proof while in use cover.
 - 5. FS or FD boxes.
 - 6. Locations as indicated.

2.03 SWITCHES:

- A. General:
 - 1. All switches and associated materials shall bear the appropriate UL label.
 - 2. Provide all necessary wiring and accessories as required for complete installation.
- B. All single-pole, double-pole, three-way, and four-way switches as indicated.
- C. Flush-Mounted, Tumbler, Self-Grounding, Heavy-Duty Switches:
 - 1. Rated 20A at 120 or 277Vac.
 - 2. Quiet type.
 - 3. "Specification" grade, Fed. Spec. W-S-896.
 - 4. Gray toggle in all areas with 302 stainless steel wall plates.
 - 5. Back and side wired design.

SECTION 26 27 26 – WIRING DEVICES: continued

- a. Screw terminal installation unless indicated otherwise.
6. With grounding lug.
- D. Surface-Mounted, Tumbler, Self-Grounding, Heavy-Duty Switches:
 1. Rated 20A at 120V or 277Vac.
 2. "Specification" grade (Fed. Spec. W-S-896) switch with gray toggle.
 3. FS and FD single or multiple gang cast copper-free aluminum boxes.
 4. Cast aluminum cover plates and matching countersunk screws.
 5. Locations indicated.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General:
 1. Install wiring devices and accessories in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
 2. Coordinate with other work, including painting, electrical boxes, and wiring installation.
 3. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
 4. Install wiring devices only in electrical boxes which are clean, free from building materials, dirt, and debris.
 5. Wiring devices shall not be installed in boxes until wire pulling is completed.
 6. Painting work shall be completed prior to device wall plate installation.
- B. Receptacles:
 1. Mount receptacles outlets 1'-6" (450 mm) above floor, walkways, or finished grade unless indicated otherwise.
- C. Switches:
 1. Mount 4 feet (1.2 meters) above floor, walkways, or finished grade unless indicated otherwise.
 2. Install close to trim on lock side when located near doors.
- D. Wiring Circuits:
 1. Home Run Groupings:
 - a. Group in home runs with not more than one conductor of each phase and 100% sized neutral and ground wire in one conduit.
 - b. Circuits which are protected by ground fault circuit interrupter (GFCI) devices shall use their own separate and isolated neutral between the GFCI device and load.
 2. Use circuit numbers as indicated.
 3. Use type SVN3 wire for lighting and receptacle circuits unless indicated otherwise.
 4. Do not install wire smaller than No. 12 AWG.
 5. Install larger size wire as indicated or required to conform to requirement of NEC.
 6. Install in concealed and exposed conduit systems as indicated.

3.02 PROTECTION:

- A. Protect installed devices from damage.
- B. Devices and wall plates that are damaged, stained, or painted shall be replaced prior to final acceptance.

SECTION 26 27 26 – WIRING DEVICES: continued

3.03 FIELD QUALITY CONTROL:

A. Testing:

1. Prior to energizing circuits, test wiring for electrical continuity and for short-circuits. Ensure proper polarity of connections is maintained.
2. After circuits are energized, test wiring devices and demonstrate compliance with requirements.
 - a. Test each receptacle with a receptacle tester to ensure proper polarity.
 - b. Test ground fault circuit interrupters with the local test button and with a receptacle tester to simulate a remote ground fault.

END OF SECTION 26 27 26

SECTION 26 29 13 –ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section specifies starters, contactors, push buttons, switches, indicating lights, relays, and motor controller work as indicated and specified.

1.03 RELATED REQUIREMENTS:

- A. Refer to applicable DIVISION 26 Sections for wires/cables, grounding, identification, electrical raceways, and boxes and fittings required in connection with enclosed controllers.
- B. Section 26 05 53 – Identification for Electrical Systems.

1.04 REFERENCE STANDARDS:

- A. National Electrical Manufacturers Association (NEMA):
 - 1. 250 – Enclosures for Electrical Equipment (1,000V Maximum).
 - 2. ICS 1 – General Standards for Industrial Control Systems.
 - 3. ICS 2 – Industrial Control Devices, Controllers, and Assemblies.
 - 4. ICS 3 – Industrial Systems.
 - 5. ICS 6 – Enclosures for Industrial Controls and Systems.
 - 6. KS 1 – Enclosed Switches.
 - 7. MG1 – Motors and Generators.
- B. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC): Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC Articles 200, 250, 430 and 702 as applicable to installation and construction of enclosed controllers.
- C. Underwriters Laboratories (UL): Provide controllers and components which are UL-listed and labeled.
 - 1. 50 – Enclosures for Electrical Equipment.
 - 2. 98 – Enclosed and Dead-Front Switches.
 - 3. 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 4. 508 – Electric Industrial Control Equipment.

1.05 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 26 05 10 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for Submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's data and installation instructions on motor controllers, contactors, push buttons, selector switches, indicating lights and relays.
 - 2. Shop Drawings: Submit Shop Drawings of motor controllers showing dimensions and weights. Submit dimensional data on push buttons, selector switches, indicating lights and relays.
 - a. Show tabulations of the following:
 - (1) Each installed unit's type and details.
 - (2) Factory-installed devices.
 - (3) Nameplate legends.
 - (4) Short-circuit current rating of integrated unit.

SECTION 26 29 13 – ENCLOSED CONTROLLERS: continued

- (5) Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 3. Wiring Diagrams: Submit power and control schematic and wiring diagrams for motor controllers and contactors. Differentiate between portions of wiring which are manufacturer factory installed and portions which are field-installed.
 4. Field quality-control reports.
 5. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.
- C. Closeout Submittals:
1. Information listed above.
 2. “As-Built” drawings.
 3. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. Include the following as minimum:
 - a. Routine maintenance requirements for enclosed controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - c. Manufacturer's written instructions for setting field-adjustable overload relays.
- 1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING:
- A. Deliver Equipment and components properly packaged in factory-fabricated type containers.
 - B. Store Equipment and components in original packaging and in a clean dry space; protect from weather and construction traffic.
 - C. Handle Equipment and components carefully to avoid breakage, impact, denting, and scoring of finishes. Do not install damaged Equipment; replace and return damaged units to Equipment manufacturer.
- 1.07 COORDINATION, SEQUENCING AND SCHEDULING:
- A. Sequence equipment installation work with other work to minimize possibility of damage and soiling during remainder of construction period.
 - B. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- 1.08 QUALITY ASSURANCE:
- 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 NFPA 70.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Subject to compliance with requirements, provide motor controllers, contactors, push buttons, switches, indicating lights, and relays of one of the following:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. Cutler-Hammer, Eaton.
 3. Square D, Schneider Electric.

SECTION 26 29 13 – ENCLOSED CONTROLLERS: continued

2.02 COMBINATION MAGNETIC MOTOR STARTERS:

- A. Full-voltage, nonreversing, NEMA style, with motor circuit protector (MCP) type disconnect.
- B. Minimum NEMA Size 1.
- C. Motor Circuit Protector:
 - 1. Shall be provided with an external handle that clearly indicates when the MCP is "ON," "OFF," or "TRIPPED" and be lockable in the "OFF" position.
 - 2. Molded-case, manually-operated, 3-pole.
 - 3. Adjustable, instantaneous-trip, magnetic-only-type circuit breaker.
 - 4. Coordinated unit rating for circuit protector and starter.
- D. Interrupting rating of 22,000 A RMS Symmetrical minimum unless indicated otherwise.
- E. Provide with solid-state, self-powered overload relay sized for and adjusted to full load current of motor being protected. Overload relay shall be manually reset and provide phase loss protection.
- F. External manual reset of overload relay from outside of the enclosure.
- G. Built-in 480/120V control transformer on 480V units of adequate capacity for all control devices as indicated on Contract Drawings.
- H. Auxiliary contacts as required by Contract Drawings.
- I. Momentary or maintained start-stop push buttons, selector switches, control switches, control relays, and indicating lights to implement control sequence indicated.
 - 1. Heavy duty, 30 mm units.
 - 2. Start pushbuttons shall have a green operator.
 - 3. Stop pushbuttons shall have a red operator.
 - 4. 120Vac cluster LED, push to test type indicating lights.
 - 5. Green lights shall indicate "Equipment On".
 - 6. Red lights shall indicate "Equipment Off".
 - 7. Amber lights shall indicate "Equipment Failure".
- J. Unless otherwise indicated, provide with the following NEMA enclosures:
 - 1. NEMA 4X enclosures for outdoor areas.
 - 2. NEMA 1 enclosures for interior finished areas and electrical rooms.

2.03 CONTACTORS:

- A. Magnetically held contactor.
- B. Rated 600Vac.
- C. Number of poles: As indicated or required.
- D. 30Amp rated contacts unless indicated otherwise.
- E. Auxiliary control devices, push buttons, and indicating lights as indicated.
- F. Unless otherwise indicated, provide with the following NEMA enclosures:
 - 1. NEMA 4X enclosures for outdoor areas.
 - 2. NEMA 1 enclosures for interior finished areas and electrical rooms.

2.04 SAFETY SWITCHES:

- A. Provide as required by NEC, specified or indicated.
- B. Positive quick-make, quick-break mechanism, visible blades, and line terminal shield.
- C. Single throw or double throw type when specified for source or load transfer.
- D. Provide number of poles as indicated.
- E. Provide auxiliary contact for interlocking with motor starter when indicated.
- F. Furnish heavy duty type.
- G. Unless otherwise indicated, provide with the following NEMA enclosures:
 - 1. NEMA 4X enclosures for outdoor areas.

SECTION 26 29 13 – ENCLOSED CONTROLLERS: continued

2. NEMA 1 enclosures for interior finished areas and electrical rooms.

2.05 CONTROL STATIONS:

- A. NEMA 4X, 316-stainless steel enclosure.
- B. Heavy duty, NEMA 4X rated, 30 mm pushbuttons and selector switches with number of contacts as required. Contacts shall be rated a minimum of 10 Amps at 120Vac.
- C. Start pushbuttons shall have a green operator.
- D. Stop pushbuttons shall have a red operator.
- E. Emergency Stop pushbuttons shall have red mushroom head operators.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise 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 26 05 33 – RACEWAYS, BOXES, AND SUPPORTS FOR ELECTRICAL SYSTEMS.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 468A and the National Electrical Code.

3.03 IDENTIFICATION:

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS.
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved nameplate.
 3. Label each enclosure-mounted control and pilot device.

3.04 GROUNDING:

- A. Provide equipment grounding connections for motor controller and control equipment as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding. Grounding shall conform to SECTION 26 05 26.

3.05 FIELD QUALITY CONTROL:

- A. Perform tests and inspections.
- B. Tests and Inspections:

SECTION 26 29 13 – ENCLOSED CONTROLLERS: continued

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 3. Test continuity of each circuit.
 4. Check all equipment grounds for continuity.
 5. Remove all blocking used for shipments.
 6. Verify that voltages at controller locations are within $\pm 10\%$ of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
 7. Test each motor for proper phase rotation.
 8. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 9. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 10. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed controllers will be considered defective if they do not pass tests and inspections.

3.06 ADJUSTING AND CLEANING:

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

3.07 DEMONSTRATION:

- A. Upon completion of installation of motor controller and control equipment and electrical circuitry, energize circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

END OF SECTION 26 29 13

SECTION 26 50 00 – LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Interior Luminaires:
 - a. Light-emitting Diode (LED).
 - 2. Exterior luminaires.
 - a. High-intensity discharge (HID):
 - (1) High Pressure Sodium (HPS).
 - 3. Ballasts and drivers.
 - 4. Emergency ballasts.
 - 5. Lamps.
 - 6. Luminaire accessories.
 - 7. Light Sensitive Control Devices.

1.03 RELATED REQUIREMENTS:

- A. Section 26 05 10 –General Electrical Requirements.
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- C. Section 26 05 33 – Raceways, Boxes, Seals, and Fittings for Electrical Systems.
- D. Section 26 27 26 – Wiring Devices.
- E. Section 26 29 13 – Enclosed Controllers: Lighting contactors.

1.04 REFERENCE STANDARDS:

- A. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):
 - 1. C62.41.2 – Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits; 2002 (Cor 1, 2012).
 - 2. C82.4 – American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type); 2002.
- B. Illuminating Engineering Society of North America (IESNA).
- C. National Electrical Contractors Association (NECA):
 - 1. NECA 1 – Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
 - 2. NECA/IESNA 500 – Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
 - 3. NECA/IESNA 501 – Recommended Practice for Installing Exterior Lighting Systems; 2006.
 - 4. NECA/IESNA 502 – Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 410 – Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association; 2011.

SECTION 26 50 00 – LIGHTING: continued

- E. National Fire Protection Associations (NFPA):
 - 1. NFPA 70 – National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 2. NFPA 101 – Life Safety Code; National Fire Protection Association; 2012.
- F. Underwriters Laboratories (UL):
 - 1. UL 924 – Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
 - 2. UL 1029 – High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
 - 3. UL 1598 – Luminaires; Current Edition, Including All Revisions.
 - 4. UL 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the Work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, and other potential conflicts installed under other sections or by others.
 - 3. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.06 SUBMITTALS:

- A. Refer to SECTION 01 33 00 – Submittals and SECTION 26 05 10 – General Electrical Requirements, for administrative and procedural requirements for submittals.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features. Arrange in order of luminaire designation.
 - 1. Ballasts: Include ballast factor, wiring diagrams and list of compatible lamp configurations.
 - 2. Lamps: Include rated life, color temperature, color rendering index (CRI), initial and mean lumen output, and energy efficiency data.
 - 3. Emergency Ballasts: Include list of compatible lamp configurations associated lumen output, and battery and charger data.
 - 4. Provide means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

SECTION 26 50 00 – LIGHTING: continued

- D. Field Quality Control Reports.
 - E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
 - F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
 - 1. Provide a list of all lamp types used on the Project; use ANSI and manufacturers' codes.
 - G. Project Record Documents: Record actual connections and locations of luminaires, pole foundations, any associated pull or junction boxes, and any remote components.
- 1.07 QUALITY ASSURANCE:
- A. Conform to requirements of NFPA 70.
 - B. Provide luminaires from a single manufacturer for each luminaire type.
 - C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
- 1.08 DELIVERY, STORAGE, AND PROTECTION:
- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 501 (exterior lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
 - B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- 1.09 FIELD CONDITIONS:
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.10 WARRANTY:
- A. Interior Lighting:
 - 1. Provide two year manufacturer warranty for all interior luminaires unless specified otherwise.
 - 2. LED luminaires shall have a minimum 5 year manufacturer warranty.
 - 3. Provide three year full warranty for batteries for emergency lighting units.
 - B. Exterior Lighting:
 - 1. Provide two year manufacturer warranty for all exterior luminaires.
 - C. Repair or replace all luminaires and lighting poles that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than two years from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Luminaires:
 - 1. Acuity Brands, Inc.
 - a. Holophane.
 - b. Lithonia.
 - 2. Cooper Lighting, a division of Eaton
 - 3. CPM Lighting, Inc. (Columbia-Prescolite-Moldcast).
 - 4. Hubbell Lighting, Inc.

SECTION 26 50 00 – LIGHTING: continued

5. KIM Lighting, Inc.
 6. HE Williams.
 - B. Ballasts and Drivers:
 1. General Electric Company/GE Lighting.
 2. Iota Engineering.
 3. Lutron Electronics Company, Inc.
 4. Osram Sylvania.
 5. Philips Lighting Electronics/Advance.
 6. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
 - C. Emergency Ballasts and Drivers:
 1. Iota Engineering, LLC.
 2. Lithonia Lighting.
 3. Philips Emergency Lighting/Bodine.
 4. Manufacturer Limitations: Where possible, for each type of luminaire provide emergency power supply units produced by a single manufacturer.
 - D. Lamps:
 1. General Electric Company/GE Lighting.
 2. Osram Sylvania.
 3. Philips Lighting Company.
 4. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
 - E. Light Sensitive Control Devices:
 1. Intermatic, Inc.
 2. Fisher-Pierce, Sunrise Technologies of the Electro Switch Corporation.
- 2.02 LUMINAIRE TYPES:
- A. Furnish products as indicated in the luminaire schedule included on the drawings.
- 2.03 LUMINAIRES:
- A. Provide products that comply with requirements of NFPA 70.
 - B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
 - C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
 - D. Provide products with lamp base complying with ANSI C81.61.
 - E. Provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
 - F. Provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc., as necessary for a complete operating system.
 - G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
 - H. Interior Luminaire Materials:
 1. Metal Parts:
 - a. Free of burrs and sharp corners and edges.
 - b. Sheet metal components shall be steel unless otherwise specified or indicated.
 - c. Form and support to prevent warping and sagging.
 2. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

SECTION 26 50 00 – LIGHTING: continued

- prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
3. Diffusers and Globes:
 - a. Acrylic Diffusers: 100% virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - b. Glass: Annealed crystal glass unless otherwise specified or indicated.
 - c. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise specified or indicated.
 4. Housings:
 - a. Extruded-aluminum housing and heat sink.
 - b. Painted finish after fabrication, finish as indicated in luminaire schedule.
 5. Conduit: As specified and indicated.
 6. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - a. Label shall include the following lamp characteristics:
 - (1) "USE ONLY" and include specific lamp type.
 - (2) Lamp diameter, shape, size, wattage, and coating.
 - (3) ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - (4) CCT and CRI for all luminaires.
 7. Metal Finishes:
 - a. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within a range approved by the Engineer.
- I. Exterior Luminaire Materials:
1. Metal Parts: Free of burrs and sharp corners and edges.
 2. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
 3. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
 4. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
 5. Exposed Hardware Material: Stainless steel.
 6. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 7. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
 8. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - a. White Surfaces: 85%.
 - b. Specular Surfaces: 83%.
 - c. Diffusing Specular Surfaces: 75%.
 9. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

SECTION 26 50 00 – LIGHTING: continued

10. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish and color of pole or support materials.
 11. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - a. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - b. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - (1) Color: Dark bronze unless specified or indicated otherwise.
 12. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - a. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - b. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - c. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - d. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - (1) Color: Dark bronze unless specified or indicated otherwise.
 13. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - a. Label shall include the following lamp and ballast characteristics:
 - (1) "USES ONLY" and include specific lamp type.
 - (2) Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - (3) ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - (4) CCT and CRI for all luminaires.
- J. LED Luminaires:
1. General:
 - a. LED Luminaire Components: UL 8750 recognized or listed as applicable. Tested according to LM-79.
 2. LED Luminaires with Integral LEDs:
 - a. Correlated Color Temperature (CCT): 4,000K (neutral) unless otherwise indicated.
 - b. Color Rendering Index (CRI): Refer to the Luminaire Schedule on the Contract Drawings.
 - c. Average Rated Life: Not less than 50,000 hours for an operating cycle of three hours per start.

SECTION 26 50 00 – LIGHTING: continued

- d. LED Assembly shall be mounted to die cast aluminum housing for thermal management.
- e. LED drivers shall have a power factor greater than 0.90 lagging and less than 20 percent total harmonic current distortion (THD).
- f. Operating temperature of LED assembly and fixture shall be rated for a minimum of -30 to +40°C ambient.
- g. Fixture shall be UL listed for operation in damp locations.

2.04 BALLASTS:

- A. General:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. High Intensity Discharge (HID) Ballasts: Complying with ANSI C82.4 and listed and labeled as complying with UL 1029.
 - 1. Electronic Metal Halide Ballasts:
 - a. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of $\pm 10\%$.
 - b. Total Harmonic Distortion: Not greater than 15%.
 - c. Power Factor: Not less than 0.90.
 - d. Provide Class P thermal protection with automatic reset.
 - e. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
 - f. Lamp Operating Frequency: Less than 200 Hz or as required to avoid acoustic resonance in lamp arc tube.
 - g. Lamp Current Crest Factor: Not greater than 1.5.
 - h. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of -22°F (-30°C).
 - i. Rated Ambient Operating Temperature: 130°F (54°C).
 - j. Provide end of lamp life automatic shutdown circuitry.
 - k. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
 - l. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 18, for Class A, non-consumer application.
 - m. Instant-Restrike Device: Integral with ballast or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 - 2. High Pressure Sodium Ballasts:
 - a. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of $\pm 5\%$.
 - b. Power Factor: Not less than 0.90 unless otherwise indicated.
 - c. Lamp Starting Temperature: Capable of starting lamp(s) at a minimum of -22°F (-30°C).

2.05 LED EMERGENCY DRIVERS:

- A. Description: Self-contained, battery powered, LED emergency driver units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

SECTION 26 50 00 – LIGHTING: continued

- B. Compatibility:
 - 1. Drivers: Compatible with AC drivers and LED loads rated for Class 2 output.
 - 2. Lamps: Compatible with LED lamp manufacturer supplied.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the emergency driver for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Emergency drivers shall include sufficient time delays to prevent overcurrent of the LED's in the event both emergency and standard drivers supply load simultaneously.
- E. Battery:
 - 1. Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated. Minimum of 7 year life expectancy.
 - 2. Recharge time shall be 24 hours or less.
- F. Emergency Illumination Output:
 - 1. Luminaires with LED Strip lamps:
 - a. Operate at a minimum of 1,300 lumens unless otherwise indicated.
- G. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.
- H. Operating Temperature: From 32°F (0°C) to 122°F (50°C) unless otherwise indicated or required for the installed location.

2.06 LAMPS:

- A. All Lamps:
 - 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
 - 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
 - 3. Lamp Bases: Comply with ANSI C81.61.
 - 4. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
 - 5. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Engineer to be inconsistent in perceived color temperature.
- B. LED Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
 - 1. Correlated Color Temperature (CCT): 4000K unless otherwise indicated.
 - 2. Color Rendering Index (CRI): Not less than 80.
 - 3. Average Rated Life: Not less than 50,000 hours for an operating cycle of three hours per start.
- C. High Intensity Discharge (HID) Lamps: Wattage as indicated, with bulb type, burning position, and base type as required for luminaire.
 - 1. Metal Halide Lamps: Complying with ANSI C78.43.
 - a. Non-Reflector Type Metal Halide Lamps: Phosphor coated lamp finish unless otherwise indicated.
 - b. Provide ANSI type O-rated protected metal halide lamps where required for open luminaires provided with compatible exclusionary sockets.
 - c. Correlated Color Temperature (CCT): 4000K unless otherwise noted.
 - d. Color Rendering Index (CRI): Not less than 65.

SECTION 26 50 00 – LIGHTING: continued

2.07 LIGHT SENSITIVE CONTROL DEVICES:

- A. Rated for multiple control of HID lighting as indicated.
- B. Turns lights "on" at 3 footcandles, "off" at 12 footcandles.
- C. Flush-mounted, weatherproof cell rated 1000-watts at 120Vac.
- D. Operates from -40°C to 70°C (-40°F to 158°F).
- E. Intermatic 4000 Series or Fisher-Pierce FT15.
- F. FD box.
- G. Locations as indicated.
- H. Contactors: As specified in Specified in Section 26 29 13 – Enclosed Controllers.

2.08 ACCESSORIES:

- A. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4 inch size, field-painted as directed.
- B. Wires for Suspended Luminaires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gauge (2.68 mm).
- C. Wires for Suspended Luminaires in Humid or Corrosive Spaces: ASTM A580/A580M, composition 302 or 304, annealed stainless steel, 12 gauge (2.68 mm).

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION:

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION:

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 as required for installation of luminaires provided under this Section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), NECA 501 (exterior lighting), and NECA 502 (industrial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100% of luminaire weight and vertical force of 400% of luminaire weight.
- F. Suspended Luminaires:

SECTION 26 50 00 – LIGHTING: continued

1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet (1.2 m) between supports.
 4. Install canopies tight to mounting surface.
 5. Where longer than 48 inches (1200 mm), brace to limit swinging.
 6. Unless otherwise indicated, support pendants from swivel hangers.
 7. Provide damping of luminaire oscillations where needed.
- G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
1. Attach luminaire per manufacturer's recommendations.
- H. Install accessories furnished with each luminaire.
- I. Provide seismic bracing and support such that the light fixtures and/or lamps will not fail during a seismic event.
- J. Bond products and metal accessories to branch circuit equipment grounding conductor.
- K. Emergency Ballasts and Drivers:
1. For field-installed units, install inside luminaire unless otherwise indicated. Where installation inside luminaire is not possible, install on top of luminaire.
 2. Unless otherwise indicated, connect unit to un-switched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
- L. Install lamps in each luminaire.
- M. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- N. Light Sensitive Control Devices:
1. Direct toward the north sky where possible.
 2. Set the adjustable control to operate at the specified foot-candle level.
 3. Install as indicated.
 4. Connect to control lighting fixtures indicated.
- 3.04 FIELD QUALITY CONTROL:
- A. Inspect each product for damage and defects.
 - B. Operate each luminaire after installation and connection to verify proper operation.
 - C. Test emergency ballast units to verify proper operation upon loss of normal power supply.
 - D. Verify operation of photoelectric controls.
 - E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.
 - F. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- 3.05 ADJUSTING:
- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.

SECTION 26 50 00 – LIGHTING: continued

3.06 CLEANING:

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 501 (exterior lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES:

- A. See Section 01 78 00 - Closeout Submittals for closeout submittals.
- B. Demonstration: Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.
- C. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION:

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 50 00

DIVISION 28 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section describes the requirements for security access control and intrusion detection systems. The systems shall be user-configurable and scalable.
- B. The completed system shall include, but not be limited to, the following major components:
 - 1. Security access control and monitoring software updates.
 - 2. Network Access controllers.
 - 3. Access control panels.
 - 4. Door hardware with integrated strike locks and panic bars specified in SECTION 087000.
 - 5. Door contacts.
 - 6. Card readers.
 - 7. Power supplies as required.
- C. The Contractor shall be responsible for providing fully operational security access control and intrusion detection system components as indicated on drawings. All necessary hardware and software updates required for the fully-operational system shall be the responsibility of the Contractor and shall be provided at no additional cost to the Owner.
- D. The Owner has an existing system utilizing International Electronics, Inc (IEI) access control equipment. The new equipment shall be provided and installed by Brian and Dale's Lock & Safe Inc, 1600 Rogers Ave, Fort Smith, AR 72901, (479) 782-2592.
- E. Coordinate with the door vendor for door lock type and door hardware.
- F. All equipment shall be UL listed.

1.03 RELATED REQUIREMENTS:

- A. SECTION 26 05 19 – Electrical Power Conductors and Cables.
- B. SECTION 26 05 26 – Grounding and Bonding for Electrical Systems.
- C. SECTION 26 05 33 – Raceways, Boxes, and Supports for Electrical Systems.
- D. SECTION 40 95 33 – Process Control Networks.
- E. SECTION 08 70 00 – Finish Hardware.

1.04 REFERENCE STANDARDS:

- A. Electronic Components Industry Association (ECIA):
 - 1. EIA/ECA-310-E – Cabinets, Racks, Panels, and Associated Equipment.
- B. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC).
- C. National Electrical Manufacturers Association (NEMA):
 - 1. 250 – Enclosures for Electrical Equipment (1,000V maximum).
- D. Underwriters Laboratories (UL):
 - 1. 50 – Enclosures for Electrical Equipment.

1.05 SUBMITTALS:

- A. Submit as specified in DIVISION 01.

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION:
CONTINUED

- B. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.
- C. Product Data: Submit the following for each type of product specified and included as minimum:
 - 1. Data sheets for all components furnished.
- D. Qualification Statements:
 - 1. Fabricator's qualifications.
- E. Shop Drawings: Provide the following as minimum:
 - 1. Fabrication drawings, front elevation, wiring diagrams, and bills of material for access control panels.
 - 2. Electrical connection diagrams showing termination locations for all field wiring. External connection diagrams shall indicate cable number and wire color for field cables terminated at the panel.
 - 3. Engraving schedule and physical dimensions for nameplates.
- F. Special Procedure Submittals:
 - 1. Test Plan:
 - a. Provide a complete and detailed test plan for the supplied access control panels.
 - b. Include procedures for certification, validation, and testing.
 - 2. Syllabus for Owner training.
- G. Test and Evaluation Reports:
 - 1. Factory test reports.
 - 2. Field test reports.
- H. Closeout Submittals: Final documentation shall include the following as minimum:
 - 1. Operation and Maintenance Manuals including the following:
 - a. Operation and maintenance manuals for all components furnished.
 - b. Certified "As-Built"/"As-Installed" drawings.
 - c. Copies of all approved Product Data.
 - d. Copies of all approved Test Reports.
 - e. Spare parts and supply list.
 - f. Warranty Information.
 - g. Contractor Information.
- I. Maintenance Material Submittals:
 - 1. Spare Parts:
 - a. Provide five (5) spare fuses of each type used including those used in power supplies.
 - 2. Software:
 - a. Original CD/DVD-ROM disks and/or flash drives containing all software associated with the supplied equipment.
 - b. Organize and submit all software copies in a 3-ring binder.

1.06 QUALITY ASSURANCE:

- A. Materials and Equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to Bid opening.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Access control panels and associate equipment shall be packaged and shipped to the project site in such a manner as to avoid damage.

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION:
CONTINUED

- B. All equipment shall be stored according to the manufacturer's instructions and in a conditioned space to avoid condensation, dust, and other environmental contaminants.
- 1.08 PROJECT SITE CONDITIONS:
- A. Do not store or install the control panel equipment specified herein until designated installation spaces are suitable for intended service.
 - B. For indoor control panels final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to energizing panel and shall be maintained for the remainder of the construction period.
- 1.09 WARRANTY:
- A. All equipment shall be provided with a minimum one-year warranty period.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Access Control System (Controllers, control panels, software, and accessories):
 - 1. Nortek Security & Control, Linear/IEI brand.
 - B. Door Contacts:
 - 1. George Risk Industries, Inc.
 - 2. G.E. Interlogix - Sentrol.
 - 3. Honeywell.
 - 4. Engineer approved equal.
 - C. Card Readers:
 - 1. International Electronics, Inc. (IEI)
 - 2. HID Global.
 - 3. Honeywell.
 - 4. Engineer approved equal.
- 2.02 ACCESS CONTROL SYSTEM:
- A. The access control system shall include, but is not limited to, access controllers, communications adapters, access control panels, power supplies, and system software.
 - B. The access control system shall be based on the IEI Max 3 Access System.
 - C. Each Max 3 cabinet shall have a single backplane capable of supporting four individual Max 3 modules. Module quantities shall be as indicated.
 - D. Each Max 3 module shall have the following I/O capabilities:
 - 1. Inputs:
 - a. Front End Readers (IN and OUT): Wiegand.
 - b. Request to Exit (REX): Normally open loop.
 - c. Door Switch: Normally closed loop.
 - 2. Outputs:
 - a. Main Relay: Form C, SPDT, 12-24VAC/DC, 2A.
 - b. Alarm Shunt: Form C, SPDT, 12-24VAC/DC, 1A.
 - c. Door Ajar: Form C, SPDT, 12-24VAC/DC, 1A.
 - d. Forced Door: Form C, SPDT, 12-24VAC/DC, 1A.
 - E. Communications:
 - 1. The system shall include an Ethernet network gateway module (SEG-M) for each site and communicate across a TCP/IP network.

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION:
CONTINUED

2. The system shall support serial communication (RS-485) for interconnection of multiple backplanes.
- F. The system shall be expandable for control of up to 64 modules per site and be networked with unlimited sites.
- G. The peripherals, specified in this Section, shall be fully compatible with the specified access control system. The Contractor shall be responsible for integrating the peripherals to the access control system.
- H. The network cabling and all required wiring between peripherals and network components shall be provided as recommended by the equipment manufacturers.
- I. The access control system shall be fully operational with programmed information. The Contractor shall coordinate with the Owner for the programming input data.
- J. The access control system components shall be housed in a NEMA 12 lockable enclosure.
 1. The enclosure shall be ventilated and sized to accommodate all required components and dissipate the heat generated in the panel.
 2. The interconnecting cables and wires shall be neatly arranged and installed in wiring channels.
 3. The components shall be DIN rail or shelf mounted inside the enclosure and shall be secured.
 4. Provide DIN-railed mounted terminal strips, as required, inside the enclosure for all field wiring terminations, excluding communication cables. The terminal strips shall be rated for 300V applications and shall be sized to accommodate field wire sizes.
- K. Provide all required power supplies for all components housed in the security panel and all peripheral devices connected to the security panel. Power supplies shall have minimum of 25% spare capacity. All power supplies shall be provided with overload and short circuit protection and shall be mounted in the security panel.
- L. Each access control panel shall include a 7AH battery with charging system to provide backup in the event of power failure. Battery and charger shall be as recommended by the manufacturer.
- M. A tamper switch shall be provided for the enclosure and the switch shall be wired to an input in the plant control system. Provide Sentrol Model 3012 or equal.
- N. Software:
 1. The existing security system access control software shall be used.
 2. Provide any updates to the software installed on the indicated workstations for connection of the new equipment
 3. The software shall store all system transactions in a common database stored on the workstation or server. The database shall be accessible by the security workstation.

2.03 DOOR CONTACTS:

- A. Recessed mounted door contacts shall meet the following requirements:
 1. Designed for recessed mounting in the door frame.
 2. 3/4-inch diameter.
 3. Minimum 1/2-inch gap in steel doors.
 4. Hermetically sealed reed switch with matching actuating magnet.
 5. Minimum one foot lead length.
 6. Normally closed when active (door is closed).
 7. Compatible with specified access control modules.
- B. Surface mounted door contacts shall meet the following requirements:
 1. Hermetically sealed reed switch with matching actuating magnet.

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION:
CONTINUED

2. Brushed anodized aluminum housing.
3. Three foot stainless steel armored cable.
4. Mounting bracket as required.
5. Normally closed when active (door is closed).
6. Compatible with specified access control modules.
7. All mounting hardware shall be included for the installation.

2.04 CARD READER:

- A. The card reader specified herein is based on HID ProxPoint Plus 6005 Model proximity readers.
- B. The card reader shall meet the following requirements:
 1. Read range: Up to 3 inches with compatible card.
 2. Input voltage: 5–16Vdc at reader.
 3. Operating temperature: -30°C to 65°C.
 4. Enclosure: The reader shall be of potted, polycarbonate material, sealed to a NEMA rating of 4X.
 5. LED indicator with tri-color standard (red, green, amber).
 6. Audio tone.
 7. Output format: Wiegand.
 8. Frequency: 125 kHz (excitation).
 9. Factory or field programmable.
 10. Rated for indoor and outdoor installation.
 11. Compatible with specified access control modules.
- C. Provide a minimum of twenty 125 kHz HID Proximity Access Cards compatible with the owners existing system.

2.05 WIRING SYSTEM:

- A. Provide basic wiring materials which comply with SECTION 26 05 19 – Electrical Power Conductors and Cables and SECTION 26 05 33 – Raceways, Boxes, and Supports for Electrical Systems.
- B. Wire and cabling types shall be in accordance with the requirements of the system manufacturer.
- C. Provide multi-conductor cables as indicated on the drawings.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify site conditions are suitable for installation of equipment.
- B. Final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to energizing the access control panels and shall be maintained for the remainder of the construction period.

3.02 INSTALLATION:

- A. The security access control and intrusion detection systems, specified herein, shall be installed by trained and qualified personnel who have minimum of five (5) years of experience installing similar systems. All components shall be installed in accordance with the manufacturer's installation manuals and recognized industry practices.
- B. Provide all labor, materials, startup, programming, etc. for a fully functioning system.

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION:
CONTINUED

- C. Mount equipment plumb, level, square, and secure.
- D. Installation of basic wiring system materials:
 - 1. Install wiring, raceways, and electrical boxes and fittings in accordance with SECTION 26 05 19 – Electrical Power Conductors and Cables and SECTION 26 05 33 – Raceways, Boxes, and Supports for Electrical Systems.
 - 2. Install all wiring in raceways.
 - 3. Where possible, install wires and cables without splices. Make connections and splices at terminal strips in terminal boxes, cabinets or at equipment terminals.

3.03 PROGRAMMING:

- A. The access control system shall be programmed to allow access to the indicated areas. Coordinate with the Owner for a complete list of employees and access control rights.
- B. Program the database tags, descriptions, and alarm reports in a clear and concise manner.
- C. The security system shall be programmed to provide the indicated outputs to the plant control system.
- D. The security access control for a typical man door shall meet the following sequence of operations:
 - 1. Normal Request for Entry: The security access control system shall actuate the man door electric strike when the request for entry is made via the man door card reader. The electric strike shall be released and remain released for 10 seconds before the system secures the electric strike.
 - 2. Normal Request to Exit: The man door shall be designed for a free exit using a request to exit push bar device located on the door interior. The request to exit push bar device shall initiate a contact closure to the access control module exit circuit. The access control module shall release the electric strike and give a permissive to the system for a free exit. The system shall incorporate a 10 second time delay after the request to exit is given to complete the exit cycle.

3.04 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Services:
 - 1. The equipment supplier shall provide the field services of a trained technician for the amount of time required to commission, test and start-up all equipment provided.
 - 2. All travel and living expenses shall be included for all trips to the site. All equipment required for testing, start-up and performance verification shall be provided by the start-up technician.
- B. Check all internal and external connections and tighten as required.
- C. Perform I/O checkout on all points and verify proper operation.
- D. Verify proper connection of communication cabling and proper communication system configuration.
- E. Field verify proper operation of all inputs and outputs.
- F. Record results of I/O checkout and submit test reports as specified in DIVISION 01.

3.05 ADJUSTING AND CLEANING:

- A. After field installation and final wiring terminations are completed the access control panel wiring and cables shall be adjusted and neatly secured with tie wraps, hook-and-loop straps, or the like.
- B. Wiring duct covers shall be replaced and secured as required.

SECTION 28 10 00 – ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION:
CONTINUED

- C. Prior to final acceptance control panel interior and exterior shall be wiped clean and free from dust and debris.

3.06 TRAINING:

- A. Provide a minimum of 2 hours of training at the customer's facility for operations, maintenance and service personnel.
 - 1. The training session shall include classroom discussion on the theory of operation of the equipment, as well as maintenance and service methods for the purchased equipment.
 - 2. Topics covered shall include safety, hardware layout and functions, power and control wiring, diagnostic indicators, keypad/display interface, faults, diagnostic tools, troubleshooting, and preventive maintenance.
 - 3. Hands-on training shall be provided on equipment.
 - 4. Documentation shall be provided which shall include actual manuals for the equipment and drawings and schematics of equipment supplied for this project.
- B. The Owner at their option shall be allowed to video record all training sessions for future reference.

END OF SECTION 28 10 00

DIVISION 31 - EARTHWORK

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes all subgrade preparation, excavating, trenching, filling, embankment construction, backfilling, compacting, grading, topsoiling, and all related items necessary to complete the Work indicated or specified.

1.02 REFERENCES:

- A. Applicable Standards:
 1. American Society for Testing and Materials (ASTM) (Equivalent AASHTO standards may be substituted as approved):
 - a. C33 - Concrete Aggregates.
 - b. C88 - Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - c. C94/C94M - Ready-Mix Concrete.
 - d. C144 - Aggregate for Masonry Mortar.
 - e. C150 - Portland Cement.
 - f. C173/C173M - Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - g. C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - h. C403/C403M - Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
 - i. C618 - Coal Fly Ash and Raw or Natural Pozzolan for Use as a Mineral Admixture in Concrete.
 - j. C939 - Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - k. C940 - Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - l. D75 - Practice for Sampling Aggregates.
 - m. D422 - Test Methods for Particle-Size Analysis of Soils.
 - n. D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
 - o. D1140 - Test Methods for Amount of Material in Soils Finer than the No. 200 Sieve.
 - p. D1241 - Materials for Soil-Aggregate Subbase, Base, and Surface Courses.
 - q. D1556 – Test Method for Density and Unit Weight of Soil In-place by the Sand Cone Method.
 - r. D1557- Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).
 - s. D2167 - Test Method for Density and Unit Weight of Soil in-Place by the Rubber Balloon Method.
 - t. D2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - u. D3776 – Test Methods for Mass per Unit Area (Weight) of Fabric.

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

- v. D4253 - Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - w. D4254 - Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - x. D4318 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - y. D4546 - Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils.
 - z. D5084 - Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
 - aa. D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- 2. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR Part 1926 - Safety and Health Regulations for Construction.
 - 3. Standard Specifications for Road and Bridge Construction, State of Arkansas.
- 1.03 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Includes, but not limited to, the following:
 - 1. Test results from laboratory testing of proposed borrow material.
 - 2. Test results from laboratory testing of granular material and trench stabilization material.
 - 3. Erosion control plan.
 - 4. Dewatering Plan.
 - 5. Sheet piling and Shoring Excavation Plan.
 - C. Where selecting an option for excavation, trenching, and shoring in compliance with local, state, or federal safety regulations such as OSHA 29 CFR Part 1926 or successor regulations, which require design by a registered professional engineer, submit (for information only and not for Engineer approval) the following:
 - 1. Copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located.
 - 2. Documents provided with evidence of registered professional engineer's seal, signature, and date in accordance with appropriate state licensing requirements.
- 1.04 QUALITY ASSURANCE:
- A. Sampling and Testing:
 - 1. Tests to determine conformance with all requirements of this Specification for quality and properties of all Contractor -secured materials, including borrow materials (both on or off Site) proposed for use, shall be performed by an independent, commercial laboratory retained and compensated by Contractor, and approved by Engineer.
 - 2. When incorporating materials into the Project, quality control testing will be performed during construction by a testing laboratory retained and compensated by Owner.
- 1.05 PROJECT CONDITIONS:
- A. Lines and grades shall be as indicated. Owner will furnish benchmarks, base lines, and reference points as necessary to permit Contractor to layout and construct the Work properly.
 - B. Carefully maintain all benchmarks, monuments, and other reference points and replace as directed by Engineer if disturbed or destroyed.

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

- C. Temporary Erosion and Sediment Controls: Furnish, install, construct, and maintain temporary measures to control erosion and minimize the siltation of intermittent streams and the pollution of private properties. Temporary erosion and sediment control measures shall be constructed in substantial compliance with local, state, federal, and jurisdictional agency's regulations and Contract Drawings. Temporary erosion and sediment control measures shall be maintained until completion of the Work.
- D. Disposition of Utilities:
 - 1. Existing underground utilities are shown on Contract Drawings using the best information available at the time of Drawing preparation. Contractor shall identify, locate and protect all underground utilities which may be affected by construction under this Contract before starting excavation or other Site construction activities which could damage existing utilities.
 - 2. Remove or relocate only as indicated, specified, or directed. Provide a minimum 48-hours' notice to Engineer and receive written notice to proceed before interrupting any utility service.
 - 3. Adequately protect from damage all active utilities and remove or relocate only as indicated or approved.
 - 4. Report active, inactive, and abandoned utilities encountered in excavating and grading operations that are not indicated on Contract Drawings. Remove, plug, or cap as directed by Engineer.
 - 5. Provide as-constructed drawings of Underground Facilities either not shown or found at locations that differ from those shown on Contract Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS ENCOUNTERED:

- A. Suitable Materials: Materials suitable for use in embankment and fill include material that is free of debris, roots, organic matter, frozen matter, and which is free of stone having any dimension greater than 2 inches in areas requiring a high degree of compaction, or 4 inches in other embankment and fill areas:
 - 1. Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands generally exclusive of clayey and silty material with the following properties:
 - a. Are free-draining.
 - b. Impact compaction will not produce a well-defined moisture-density relationship curve.
 - c. Maximum density by impact methods will generally be less than by vibratory methods.
 - d. Generally less than 15% by dry weight of soil particles pass a No. 200 square-mesh sieve.
 - 2. Cohesive materials include materials made up predominately of silts and clays generally exclusive of sands and gravel with the following properties:
 - a. Impact compaction will produce a well-defined, moisture-density relationship curve.
 - b. Are not free draining.
- B. Unsuitable Materials: Materials unsuitable for use in embankment and fill include all material that contains debris, roots, organic matter, frozen matter, shale particles, or material containing gravel or stone with any dimension greater than 2 inches in areas requiring a high degree of compaction or 4 inches in other embankment and fill areas, or other materials that are

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

determined by Engineer as too wet or otherwise unsuitable for providing a stable subgrade or stable foundation for structures.

- C. Material used for embankment or fill:
 - 1. For soils used below structural elements, such as footings, slabs, pavements, and mats, that portion of material passing the No. 40 square-mesh sieve shall have a liquid limit not exceeding 40 and a plasticity index not exceeding 25 when tested in accordance with ASTM D4318.
- D. All Materials encountered, regardless of type, character composition and condition thereof, shall be considered “unclassified” for the purpose of payment. Determine quantity of various materials to be excavated prior to submitting Bid. Rock encountered shall be handled at no extra cost to Owner.
- E. Waste Materials:
 - 1. Waste materials, as described for purposes of this Section, consist of unsuitable materials, excess suitable material, rock, demolition debris, and other materials considered unacceptable for use as fill, and which are not environmentally contaminated. Waste materials shall not include environmental pollutants, hazardous substances, contaminated products, by-products, samples, or waste materials of any kind that are regulated under environmental laws.
 - 2. Dispose of waste materials in accordance with Paragraph 3.03E.

2.02 BORROW MATERIALS:

- A. Suitable fill materials, granular materials, and topsoil obtained from locations arranged for by Contractor (off the Site). Required to the extent sufficient suitable materials are not obtained from excavation and trenching.
- B. Obtain, excavate, haul, handle, place, and compact borrow materials.
- C. Borrow materials shall not exhibit characteristics of high shrink-swell potential as determined from Atterberg limit tests (ASTM D4318) and/or swell tests (ASTM D4546) unless otherwise specified herein.

2.03 GRANULAR MATERIAL:

- A. Crushed stone or crushed gravel indicating a loss of not more than 15% after 5 cycles when tested for soundness with sodium sulfate as described in ASTM C88 and conforming to one of the following gradations:

| Standard Square Mesh Sieve <u>U.S. Size or No.</u> | ASTM C33 No. 67 Stone <u>Percent Passing</u> |
|---|--|
| 1 inch | 100 |
| 3/4-inch | 90 to 100 |
| 3/8-inch | 20 to 55 |
| No. 4 | 0 to 10 |
| No. 8 | 0 to 5 |

Use at all locations where granular material is required unless otherwise indicated or specified.

- B. Pipe Bedding Material shall be clean, natural sand conforming to ASTM C33 (fine concrete aggregate) with not more than 5% by weight passing the No. 200 sieve.

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

| <u>Standard Square Mesh Sieve</u> <u>U.S. Size or No.</u> | <u>ASTM C33</u> <u>Percent Passing</u> |
|--|---|
| 3/8-inch | 100 |
| No. 4 | 95 to 100 |
| No. 8 | 80 to 100 |
| No. 16 | 50 to 85 |
| No. 30 | 25 to 60 |
| No. 50 | 10 to 30 |
| No. 100 | 2 to 10 |
| No. 200 | -- |

2.04 EMBANKMENT AND FILL MATERIAL:

- A. Material shall be free of roots or other organic matter, refuse, ashes, cinders, frozen earth, or other unsuitable material.
- B. Use suitable material sufficiently friable for embankment to provide a dense mass free of voids and capable of satisfactory compaction.
- C. Do not use material containing gravel, stones, or shale particles greater in dimension than one-half the depth of the layer or lift to be compacted.
- D. Moisture content shall be that required to obtain specified compaction of the soil or as indicated.
- E. Perform moisture curing by wetting or drying of the material as required to attain required compaction criteria.

2.05 TRENCH STABILIZATION MATERIAL:

- A. Granular material as specified or conform to ASTM D1241, Gradation A or B, well-graded, with not more than 10% passing No. 200 sieve.

PART 3 - EXECUTION

3.01 DEMOLITION:

- A. Remove existing pavement by jack hammering, sawing, scarifying, or other approved methods except as follows:
 - 1. Existing asphaltic or portland cement concrete pavement shall be sawed at point where pavement indicated to remain ends and pavement indicated to be removed begins.
 - 2. Existing portland cement concrete pavement shall be removed back to the nearest joint unless otherwise indicated or approved by Engineer.

3.02 SITE PREPARATION:

- A. Sediment (Silt) Fence:
 - 1. Install silt fence as indicated and as follows:
 - a. On the downslope side(s) of all disturbed areas.
 - b. On the downslope side(s) of all stockpile areas.
 - 2. Inspection:
 - a. Daily in areas of active construction or equipment operation.
 - b. Weekly in areas with no construction or equipment operation.
 - c. Within 24 hours of each 0.5-inch or greater rainfall event.
 - d. Complete inspection reports after each inspection and submit to Engineer within 2 working days.
 - 3. Maintenance:

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

- a. Remove sediment from behind silt fence when it reaches one-third the height of fence. Place removed sediment in topsoil stockpile areas.
 - b. Any silt fence damaged so it can not perform its intended function shall be replaced as indicated or as directed by Engineer.
 - c. Remove silt fence after area has been surfaced or seeded and has been accepted by Engineer.
- B. Construction Access:
1. Immediately remove by shoveling and/or sweeping all sediment tracked from the construction area onto Site access roads. Place sediment in stockpile areas.
- C. Clearing and Grubbing:
1. Perform only in areas where earthwork or other construction operations are to be performed.
 2. Protect tops, trunks, and roots of existing trees which are to remain on Site.
 3. Clear areas and dispose of other trees, brush, and vegetation before starting construction.
 4. Remove tree stumps and roots larger than 3 inches in diameter and backfill resulting excavations with compacted, suitable material.
 5. Dispose of debris from clearing and grubbing at a location off the Site, as arranged for by Contractor, at no additional cost to Owner.
- D. Stripping:
1. Remove topsoil from areas within limits of excavation, trenching and borrow, and areas designated to receive embankment and compacted fill as follows:
 2. Scrape areas clean of all brush, grass, weeds, roots, and other material.
 3. Strip to depth of approximately 6 inches or to a sufficient depth to remove excessive roots in heavy vegetation or brush areas and as required to segregate topsoil, or as directed by Engineer.
 4. Stockpile topsoil in areas where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of subsoil, debris, and stones larger than 2 inches in diameter.
 5. Remove waste from the Site.
- 3.03 EXCAVATION AND TRENCHING:
- A. Sheeting and Bracing:
1. Design, furnish, place, maintain, and subsequently remove, to the extent required, a system of temporary supports for cut and cover, open cut, or trench excavations, including bracing, dewatering, and associated items to support sides and ends of excavations where excavation slopes might endanger in-place or proposed improvements, extend beyond construction right-of-ways, or as otherwise specified or indicated.
 2. Provide all materials on Site prior to start of excavation in each section, and make such adjustments as are required to meet unexpected conditions.
 3. Space and arrange sheeting and bracing as required to exclude adjacent material and according to stability of excavation slopes.
 4. Assess existing conditions including adjacent property and possible effects of proposed temporary works and construction methods; and select and design such support systems, methods, and details as will assure safety to the public, adjacent property, and the completed Work.
 5. Modify or relocate underground facilities, at no additional cost to Owner, if existing underground facilities interfere with Contractor's proposed method of support.
 6. Use caution in areas of underground facilities, which shall be exposed by hand or other excavation methods acceptable to Owner.

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

7. Perform sheeting, shoring, and bracing in accordance with safety and protection requirements of the Contract Documents.
8. Provide sheeting, shoring, and bracing for trench excavation in subgrade of excavation when required to prevent movement of the main excavation support system.
9. Provide shoring, sheeting, and bracing as indicated or as needed to meet the following requirements:
 - a. Prevent undermining and damage to all structures, buildings, underground facilities, pavements, and slabs.
 - b. Perform excavations with vertical banks where necessary for construction activities or as indicated, and also within all limits of excavation noted on Drawings.
 - c. Design excavation support system and components to support lateral earth pressures, unrelieved hydrostatic pressures, utility loads, traffic and construction loads, and building and other surcharge loads to allow safe and expeditious construction of permanent structures without movement or settlement of the ground, and to prevent damage to or movement of adjacent buildings, structures, underground facilities, and other improvements. Design shall account for staged removal of bracing to suit the sequence of concrete placement for permanent structures and backfill.
 - d. Except as otherwise specified herein, shoring and sheeting materials may be extracted and reused at Contractor's option; however, Contractor shall remove and replace any existing structure or underground facility damaged during shoring and sheeting. Remove sheeting and bracing as backfill progresses. Fill voids left after withdrawal with sand or other material approved by Engineer.
 - e. Where shoring and sheeting materials must be left in-place in the completed Work to prevent settlements to or damage within adjacent structures or as directed by Engineer, backfill the excavation to 3 feet below finished grade and remove the remaining exposed portion of shoring before completing backfill. If soldier piles and wood lagging are used for shoring, remove wood lagging to within 3 feet of finished grade in incremental steps of approximately 6 inches as backfill is placed, or to Contractor's design if more stringent. Location of all shoring and sheeting left in-place shall be documented on Contractor-furnished construction record drawings and provided to Engineer and Owner.
10. Contractor shall be solely responsible for proper design, installation, operation, maintenance, and any failure of any component of the system. Review by Engineer of drawings and data submitted by Contractor shall not in any way be considered to relieve Contractor from full responsibility for errors therein or from the entire responsibility for complete and adequate design and performance of the sheeting and shoring system.
11. Provision for Contingencies:
 - a. Performance of components of the support system shall be monitored for both vertical and horizontal movement three times a week.
 - b. Provide a contingency plan or alternative procedure for implementation, if system does not adequately perform.
 - c. Keep materials and equipment necessary to implement the contingency plan readily available.
12. Damages:
 - a. Document all existing damage to adjacent facilities and submit information to Owner prior to performing any excavation. Documentation shall include a written description, diagrams, measurements, and appropriate photographs.

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

- b. Repair all damage resulting from Contractor's excavation and remove and replace all undermined pavements with Owner-approved equal, either concrete or asphalt, at no expense to Owner.
- B. Explosives: Blasting will not be permitted.
- C. Trenching for Underground Utilities:
 - 1. Side Walls:
 - a. Make vertical or sloped within specified trench width limitations below a plane 12 inches above top of pipe.
 - b. Make vertical or sloped (stepped) as required for stability, above a plane 12 inches above top of pipe.
 - c. Excavate without undercutting sidewalls.
 - 2. Trench Depth:
 - a. Excavate to depth sufficient to provide the minimum bedding requirements for the pipe being placed.
 - b. Do not exceed that indicated where conditions of bottom are satisfactory.
 - c. Increase depth as necessary to remove unsuitable supporting materials.
 - d. Maintain a minimum of 1.5 feet of soil cover above top of pipe.
 - 3. Trench Bottom:
 - a. Protect and maintain when suitable natural materials are encountered.
 - b. Remove rock fragments and materials disturbed during excavation or raveled from trench walls.
 - c. Restore to proper subgrade with trench stabilization material when overexcavated. Correct at no additional cost to Owner when trench is overexcavated without authority or to stabilize bottom rendered unsuitable through negligence or improper dewatering or other operations.
 - 4. Trench Width:
 - a. Excavate trench to a width which will permit satisfactory jointing of pipe and thorough tamping of bedding and backfill.
 - b. Do not exceed following trench widths:
 - (1) For single pipe installation, maintain trench widths below a plane 12 inches above top of pipe as follows:

| <u>Nominal Pipe Size</u> | <u>Trench Width</u> | |
|--------------------------|---------------------|----------------|
| <u>Less than 24"</u> | <u>Minimum</u> | <u>Maximum</u> |
| | Pipe od + 1' | Pipe od + 2' |
 - (2) Above plane defined in (1), no maximum limit.
 - (3) Maximum trench width limitations shall apply in all areas more than 3 feet from manhole or structure walls.
 - (4) Maximum width shall be as near the minimum specified as can be controlled by construction equipment and methods used.
 - 5. Fill and Embankment Areas: Perform trenching only after compacted fill or embankments have reached an elevation of not less than 1 foot above top of pipe.
 - 6. Limit maximum length of open trench to 50 feet in advance and to 50 feet behind pipe installation.
 - 7. Test Pits:
 - a. Excavate test pits sufficiently in advance of trenching to enable adequate planning of construction procedure.
 - b. Locate as follows:

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

- (1) When unstable material is suspected that may require special protective measures.
 - (2) Where groundwater may require special handling methods.
 - (3) Where indicated or otherwise approved.
 - (4) Where interference or conflict with other utilities or structures could affect alignment of pipe.
- c. To depth required to obtain information desired.
- D. Dewatering
1. Control grading around excavations to prevent surface water from flowing into excavation areas.
 2. Drain or pump as required to continually maintain, including days not normally worked, all excavations free of water or mud from any source, and discharge to approved drains or channels. Commence when water first appears and continue as required to keep excavation free of standing water during entire time excavation is open.
 3. Use pumps of adequate capacity to ensure rapid drainage of area, and construct and use drainage channels and subdrains with sumps required.
 4. When water is found in excavation due to Contractor negligence, remove unsuitable excessively wet subgrade materials and replace with approved compacted fill material as directed by Engineer and at no additional cost to Owner.
- E. Waste Materials:
1. Remove unsuitable materials from Work area as excavated.
 2. Deposit such materials in locations and within areas indicated or designated by Engineer.
 3. Material shall become property of Contractor and shall be disposed of off Site at locations arranged for by Contractor.
 4. Segregate excess suitable materials and topsoil from unsuitable materials for possible use by others. Place excavated rock in interior of waste area fills so it will not be exposed to view.
 5. Grade waste areas and leave free-draining with an orderly, neat appearance. Side slopes shall not be steeper than 3 horizontal to 1 vertical. Topsoil, seed, and mulch waste areas.

3.04 EARTHWORK:

- A. Subgrades:
1. General:
 - a. Excavate or backfill as required to construct subgrades to elevations and grades indicated.
 - b. Remove all unsuitable material and replace with acceptable fill material and perform all wetting, drying, shaping, and compacting required to prepare subgrade.
 - c. Proofrolling: Exposed area to receive fill, backfill, or embankment shall be proofrolled to detect localized zones of excessively wet, unstable, organic, or low bearing capacity materials as follows:
 - (1) Proofroll as a single-pass operation with conventional compaction equipment during subgrade preparation and prior to placement of fill, and as a spot check process without the need for complete coverage per unit area of tire. Soft spots shall be overexcavated, backfilled, and compacted with suitable material.
 2. Subgrade for Fills and Embankments: Roughen by discing or scarifying and wet or dry top 6 inches as required to bond with fill or embankment.
 3. Subgrade for Roadways:

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

- a. Extend subgrade the full width of pavement or base course, plus 1 foot in each direction.
- b. Cohesive Soil Subgrades: Compact the top 6 inches of subgrade for traffic areas in embankment or excavation to a minimum of 95% of maximum dry density within the moisture content range from 2% below optimum to 2% above optimum. Optimum moisture and maximum dry density shall be determined by ASTM D698.
- c. Cohesionless Soil Subgrades: Compact the top 6 inches of subgrade for traffic areas in embankment or excavation to not less than 80% of relative dry density as determined by ASTM Methods D4253 and D4254.
4. Subgrades for Concrete Slabs on Grade, Mats, and Footings:
 - a. Compact cohesive soil subgrades to a minimum of 95% of maximum dry density within the moisture content range from 2% below optimum to 2% above optimum. Optimum moisture and maximum dry density shall be determined by ASTM D698.
 - b. Where subgrade consists of cohesionless granular materials, compact to not less than 75% relative density as determined by ASTM D4253 and D4254.
 - c.
- B. Embankments and Fills:
 1. Construct embankments to contours and elevations indicated, using suitable approved material from excavations and borrow areas:
 - a. Place fill material in maximum 8-inch loose lifts.
 - b. Place embankment only on subgrades approved by Engineer.
 - c. Do not place snow, ice, or frozen earth in fill; do not place fill on a frozen surface.
 2. Obtain compaction by the controlled movement of compaction equipment approved by Engineer during placing and grading of layers and to minimum density specified for indicated locations.
 3. Except as indicated or specified otherwise, compact cohesive soils to a minimum of 95% of maximum dry density within the moisture content range from 2% below optimum to 2% above optimum. Optimum moisture and maximum dry density shall be as determined by ASTM D698.
 4. In areas of fill supporting structures or under paved areas, compact cohesive soils to a minimum of 95% of maximum dry density within the moisture content range from 2% below optimum to 2% above optimum. Optimum moisture and maximum dry density shall be as determined by ASTM D698.
 5. Except as indicated or specified otherwise, compact cohesionless soils to not less than 75% relative density as determined by ASTM Method D4253 and D4254.
- C. Pipe Embedment:
 1. Pipe bedding shall be as indicated, using granular material.
 2. Place granular embedment as follows:
 - a. With level bottom layer at proper grade to receive and uniformly support pipe barrel throughout its length.
 - b. Form shallow depression under each joint to facilitate jointing.
 - c. Form depression under each joint so that no part of bell or coupling is in contact with trench when pipe is placed in position.
 - d. Add second layer simultaneously to both sides of pipe with care to avoid displacement.
 - e. Complete promptly after completion of jointing operations.
 - f. Substitute for any part of earth backfill to within 2 feet of final grade at Contractor's option.
 3. Compact granular embedment as follows:

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

- a. In loose lifts not exceeding 12 inches in depth.
 - b. Rod, spade, or use pneumatic or vibratory equipment:
 - (1) As required to obtain not less than 75% relative density as determined by ASTM Method D4253 and D4254.
 - (2) Throughout depth of embedment.
 - c. Compaction using flooding or water spraying techniques will not be allowed.
 4. Earth pipe embedment shall be as indicated and shall be used at impervious trench checks. Shape trench bottom to fit pipe and backfill throughout depth of trench with impervious materials. Compact to minimum of 95% of maximum dry density within the moisture content range from 2% below optimum to 2% above optimum. Optimum moisture and maximum dry density shall be determined by ASTM D698 .
- D. Backfilling:
1. Backfill for structures and trenches shall be as specified in "Embankments and Fills," this Section, with the following additional provisions:
 2. Structures:
 - a. Backfill only after concrete has attained 70% design strength.
 - b. Backfill adjacent to structures only after a sufficient portion of structure has been built to resist imposed load.
 - c. Remove all debris from excavation prior to placement of material.
 - d. Place backfill in level loose lifts of thickness within compacting ability of equipment used but not to exceed 8 inches in thickness.
 - e. Perform backfilling simultaneously on all sides of structures.
 - f. Exercise extreme care in use of heavy equipment in areas adjacent to structures. Equipment operated within 10 feet of any wall shall not exceed 20,000 pounds gross weight.
 - g. Material above a 45° plane intersecting the footing shall not include rock fragments incapable of passing a 6-inch screen, and no shale whether disintegrated or not.
 3. Trenches:
 - a. Backfill for trenches shall be as specified for structures and as follows:
 - (1) Complete promptly upon completion of pipe embedment and approval to proceed.
 - (2) Use hand methods to a plane 12 inches above top of pipe.
 - (3) Mechanical methods shall be acceptable where hand backfill is not required.
 - (4) Backfill in lifts of thickness within compacting ability of equipment used, but not greater than 8 inches.
 - (5) Until compacted depth over conduit exceeds 3 feet , do not drop fill material over 5 feet. Distance may then be increased 2 feet for each additional foot of cover.
- E. Site Grading:
1. Excavate, fill, compact fill, and rough grade to bring Project area outside buildings to subgrades as follows:
 - a. For surfaced areas, to underside of respective surfacing or base course.
 - b. For areas to receive topsoil, to a minimum of 4 inches below finished grade.
 - c. When rock is encountered in grading areas outside buildings, overexcavate to depth specified and backfill to grade with compacted fill:
 - (1) Under surfaced areas, to 6 inches below top of respective subgrades for such areas.
 - (2) Under lawn and planted areas, to 24 inches below finished grade, except that boulder or protruding rock outcrop, if so indicated, shall be left undisturbed.

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

2. Grading:
 - a. Grade and compact all areas within Project area, including excavated and filled sections and adjacent transition areas, reasonably smooth, and free from irregular surface changes.
 - b. Degree of finish for rough grading shall be that ordinarily obtained from blade grader or scraper operations except as otherwise specified with due allowance for topsoil.
 - c. Finished grades shall generally be not more than 0.1 foot above or below those indicated.
 - d. Finish all ditches, swales, and gutters to drain readily.
 - e. Unless otherwise indicated, slope the subgrade evenly to provide drainage away from all structures in all directions at a grade not less than 1/4 inch per foot for a minimum distance of 10 feet.
 - f. Provide roundings at top and bottom of banks and at other breaks in grade.
- 3.05 TOPSOILING:
- A. Material: Use the most suitable material obtained from stripping operations and borrow when required.
 1. Placement:
 - a. Clear areas free of vegetation, rock, and other materials which would interfere with grading and tillage operations.
 - b. Bond topsoil to subgrade by scarifying subgrade to a depth of 2 inches (50 mm).
 - c. Spread topsoil to a minimum depth of 4 inches (100 mm) where grading operations have left less than 4 inches (100 mm) of topsoil in place.
 - d. Grade topsoil to bring areas to grades as indicated, to ensure that all surfaces are left in an even and properly compacted condition, and to prevent ponding of water in depressions.
 2. Cleanup:
 - a. Clean surface free of all stones or other objects larger than 2 inches in least dimension, all roots, brush, wire, grading stakes, and other objectionable materials.
 - b. Keep paved areas clean and promptly remove rock and dirt dropped upon surfacing.
- 3.06 MAINTENANCE:
- A. Protect newly graded and topsoiled areas from actions of the elements.
 - B. Fill and repair settling or erosion occurring prior to acceptance of the Work, and reestablish grades to required elevations and slopes.
 - C. Under provisions of the guarantee, correct any settlement of embankment, fill, or backfill and damages created thereby within 1 year after acceptance of the Work. Make repairs within 10 days after notification by Owner of settlement.
- 3.07 FIELD QUALITY CONTROL:
- A. Compaction:
 1. Owner will, through services of an independent laboratory, test all embankments, fills, and subgrades under this Contract to determine conformance with specified density relationships.
 2. Method of test may be either of the following at Engineer's option:
 - a. ASTM D1556
 - b. ASTM D2167.
 - c. ASTM D6938.

SECTION 31 20 50 - SITE PREPARATION AND EARTHWORK: continued

3. The frequency of in-place compaction testing including density and moisture content will be as follows:
 - a. At least one test for every 1,000 cubic yards of material placed in a mass fill.
 - b. At least one test for every 200 cubic yards of fill placed in trenches or surrounding structures.
 - c. At least one test for every 100 feet of roadway for road subgrades and crushed rock base course.
 - d. At least one test for every 500 square feet per lift in structural fill or on subgrades for foundations.
 - e. At least one test for every shift of compaction operations on a mass fill.
 4. At least one test when Engineer suspects quality of moisture control or effectiveness of compaction. Remove or scarify fill failing to meet required densities and recompact as necessary to achieve specified results.
 5. Removal of in-place material and replacement with approved new material will be required if scarifying and recompactation do not produce the required densities.
 6. Perform at least one classification test (ASTM D2487) and one moisture-density test (ASTM D698) on soil used in fill or backfill operations during construction.
 - a. Each sample shall be taken from trenches or other excavations as directed by Engineer and should be generally representative of distinguishably differing materials encountered and used for backfill or fill.
 - b. Perform one set of tests at the beginning of excavation and one additional set of tests when material properties vary (more or less plastic, different color, more or less granular, or other conditions) from the material initially tested.
 - c. Additional tests shall be performed when directed by Engineer.
 - 7.
- B. Subgrades:
1. Engineer will inspect all subgrades to determine conformance with indicated lines and grades.
 2. Subgrades for roadways shall have a maximum deviation of not more than 1/2 inch in any 10 feet when tested with a 10-foot straightedge applied parallel with and at right angles to centerlines of subgrade areas. Actual grade shall not be more than 0.1 foot from indicated grade.

END OF SECTION 312050

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 92 00 - LAWNS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following areas of Work:
 - 1. Preparation of lawn areas.
 - 2. Seeding.
 - 3. Mulching.
 - 4. Fertilizing of lawn areas.
 - 5. Maintenance.
- B. Related Work Specified Elsewhere:
 - 1. Earthwork and Site Preparation: SECTION 31 20 50.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM) - Equivalent AASHTO standards may be substituted as approved:
 - a. D977 - Emulsified Asphalt.

1.03 SUBMITTALS:

- A. Certificates:
 - 1. Seed and fertilizer shall be accompanied by certificate from vendors certifying they meet requirements of these Specifications, stating botanical name, percentage by weight, percentage of purity, germination, and weed seed for each grass seed species.

PART 2 - PRODUCTS

2.01 TOPSOIL: Specified in SECTION 31 20 50.

2.02 GRASS SEED:

- A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America and as required below.
- B. Be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller, and date on which seed was tested:
 - 1. Seed Mixture:
 - a. Shall meet City of Fort Smith standard specifications for Public Works Construction Section 290.03.
 - 2. Moldy seed or seed that has been damaged in storage shall not be used.
- C. Comply with current rules and regulations of Arkansas State Plant Board.

2.03 FERTILIZER:

- A. Commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 4% % phosphoric acid, 2% potassium, and percentage of nitrogen required to provide not less than 1 lb of actual nitrogen per 1,000 square feet of lawn

SECTION 32 92 00 - LAWNS: continued

- area. Provide nitrogen in form that will be available to the lawn during initial period of growth.
- B. Deliver to site in labeled bags or containers.
 - C. Conform to current Arkansas Fertilizer laws.
- 2.04 LIMING MATERIAL:
- A. Shall consist of agricultural liming material conforming to the Arkansas State Plant Board.
 - B. Material used for soil neutralization, unless otherwise specified, shall be agricultural lime with not less than 90% passing the No. 8 sieve and containing not less than 65% calcium carbonate equivalent.
 - C. Manufacturer's certification shall include the minimum pounds of ENM (effective neutralizing material) per ton of the material to be supplied.
- 2.05 MULCH:
- A. Vegetative Antierosion Mulch: Seed-free salt hay or threshed straw of wheat, rye, oats, barley, or other approved materials.
 - B. Seed Mulch: Peat moss in natural, shredded, or granulated form, of fine texture, with a pH of 4 to 6 and a water absorbing capacity of 1,100% to 2,000%.
 - C. Tackifiers:
 - 1. Asphalt Emulsion: Conform to ASTM D977, Type SS-1.
 - 2. Organic Glue: Hydrobond as manufactured by Erosion Control Products or approved equal.
 - D. Wood Cellulose Fiber:
 - 1. Not contain germination or growth-inhibiting ingredients.
 - 2. Dyed an appropriate color to aid in visual inspection.
 - 3. Be easily and evenly dispersed when agitated in water.
 - 4. Supply in packages of not more than 100-pound gross weight, and be marked by the manufacturer to show the air dry weight content.

PART 3 - EXECUTION

- 3.01 SOIL PREPARATION:
- A. Dispose of any growth, rocks, or other obstructions which might interfere with tilling, seeding, or later maintenance operations. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter.
 - B. Thoroughly loosen and pulverize topsoil to a depth of at least 4 inches.
 - C. Grade lawn areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions to meet finish grades. Limit fine grading to areas which can be planted within immediate future.
 - D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry off before planting of lawns. Do not create a muddy soil condition.
 - E. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
 - F. Spread planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement.
 - G. Preparation of Unchanged Grades:
 - 1. Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:
 - a. Till to a depth of not less than 6 inches.

SECTION 32 92 00 - LAWNS: continued

- b. Apply soil amendments and initial fertilizers.
- c. Remove high areas and fill in depressions.
- d. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.

3.02 LIME FERTILIZING:

- A. Lime and fertilizer shall be applied separately, but may be incorporated into the soil in one operation.
- B. Lime and fertilizer shall be applied not more than 48 hours before the seeding unless otherwise authorized by Engineer.
- C. Contractor shall take a minimum of three Samples of the topsoil stockpile and through the services of an independent laboratory have test run to ascertain the rates of applications of soil amendments required to provide at least the quantity of effective neutralizing material and fertilizers to nourish new growth.
- D. Apply lime and fertilizer at the rates recommended by soil analysis in pounds per acre to prepared seedbeds.
- E. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or raking, except where applied hydraulically on slopes steeper than 2 horizontal to 1 vertical.

3.03 FERTILIZING:

- A. Apply fertilizer at the rate of 800 pounds per acre to prepared seedbeds.
- B. Incorporate fertilizer into the soil to a depth of at least 2 inches by discing, harrowing, or raking, except where applied hydraulically on slopes steeper than 2 horizontal to 1 vertical.

3.04 SEEDING NEW LAWNS:

- A. Do not use wet seed or seed which is moldy or otherwise damaged in transit or storage.
- B. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
- C. Sow not less than rate as required by City of Fort Smith Standard Specifications for Public Works Construction Section 2.90.03.
- D. Rake seed lightly into top 1/8-inch of soil, roll lightly, and water with fine spray.
- E. Seasonal Limitations:
 - 1. Perform seeding only during the following seasons:
 - a. Spring to Fall.
- F. Methods of Application:
 - 1. Dry Seeding: Spreader or seeding machine.
 - 2. Hydroseeding: Mix seed, fertilizer and pulverized mulch with water and constantly agitate. Do not add seed to water more than 4 hours before application:
 - a. On slopes of 2 horizontal to 1 vertical or flatter, apply seed separately from fertilizer. Cover seed with soil to an average depth of 1/2-inch by raking or other approved methods.
 - b. On slopes steeper than 2 horizontal to 1 vertical, seed and fertilizer may be applied in a single operation. Incorporation into the soil will not be required.

3.05 MULCHING:

- A. Apply a mulch covering to all seeded areas.
- B. Apply vegetative mulch to loose depth of 1-1/2 inches by means of a mechanical spreader or other approved methods.
- C. Apply wood-cellulose fiber mulch hydraulically at the rate of 1,000 pounds per acre:

SECTION 32 92 00 - LAWNS: continued

1. Mulch and seed may be applied in a single operation.
 2. Apply mulch to achieve a uniform coverage of the soil surface.
 - D. Vegetative Mulch with Asphalt Emulsion:
 1. Apply vegetative mulch at the rate of 2-1/2 tons per acre.
 2. Apply asphalt emulsion at the rate of 100 gallons per ton of straw 250 gallons per acre.
 3. Mulching machine shall inject emulsified asphalt at the proper rate directly into the air stream carrying the straw.
 - E. Immediately following the application of the mulch, water the seeded area in one watering, in sufficient amount to penetrate the seedbed to a minimum depth of 2 inches. Perform so as not to cause erosion or damage to the seeded surface.
 - F. Protect seeded areas against hot, dry weather or drying winds by applying mulch not more than 24 hours after completion of seeding operations.
- 3.06 RECONDITIONING LAWNS:
- A. Recondition lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required. Recondition other existing lawn areas where indicated.
 - B. Provide fertilizer, seed, and soil amendments as specified for new lawns and as required to provide satisfactorily reconditioned lawn. Provide new planting soil as required to fill low spots and meet new finish grades.
 - C. Cultivate bare and compacted areas thoroughly to provide a good, deep planting bed.
 - D. Remove diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.
 - E. Where substantial lawn remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
 - F. Water newly planted areas and keep moist until new grass is established.
- 3.07 PROTECTION:
- A. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period until lawn is established.
- 3.08 MAINTENANCE:
- A. Mow grass to a height of 2 inches as soon as there is enough top growth to cut with mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted.
 - B. Remove weeds by pulling or chemical treatment.
 - C. Perform maintenance until the date of final acceptance.
 - D. Seeded Areas:
 1. Water as required by good practice and as necessary to obtain a flourishing cover.
 2. Repair any portion of the seeded surface which becomes gullied or otherwise damaged, or the seeding becomes damaged or destroyed.
 - E. Apply second fertilizer application after first mowing and when grass is dry. Use fertilizer which will provide not less than pound of actual nitrogen per 1,000 square feet of lawn area.

SECTION 32 92 00 - LAWNS: continued

3.09 ACCEPTANCE OF LAWNS:

- A. When lawn Work is Substantially Complete, including maintenance, Engineer and Owner will, upon request, make an inspection to determine acceptability:
 - 1. Lawn Work may be inspected for acceptance in parts agreeable to Owner, provided Work offered for inspection is complete, including maintenance.
- B. Replant rejected Work and continue specified maintenance until reinspected by Engineer and Owner and found to be acceptable.
- C. Seeded lawns will be acceptable provided requirements, including maintenance, have been complied with and healthy, uniform, close stand of specified grass is established free of weeds, bare spots, and surface irregularities.

3.10 CLEANUP:

- A. Promptly remove soil and debris created by lawn Work from paved areas. Clean wheels of vehicles prior to leaving Site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

END OF SECTION 329200

DIVISION 40 – PROCESS INTEGRATION

SECTION 40 90 00 – INSTRUMENTATION AND CONTROLS – GENERAL REQUIREMENTS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this SECTION.
- 1.02 SUMMARY:
- A. This Division includes instruments, control devices, control panels, computer hardware and system programming as specified in SECTIONS 40 90 00 – 40 96 35.
 - B. Related Work Specified Elsewhere:
 - 1. Interconnections and control of equipment: All applicable Divisions.
- 1.03 RELATED REQUIREMENTS:
- A. SECTION 40 95 13 – Process Control Panels and Hardware.
- 1.04 REFERENCE STANDARDS:
- A. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC).
 - B. Instrument Society of America (ISA).
 - 1. S20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - C. Others as specified in applicable Sections.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.
 - C. As specified in each applicable Section, this Division.
- 1.06 QUALITY ASSURANCE:
- A. General:
 - 1. The Contractor shall provide the services of a single pre-approved System Integrator (SI), to provide the material, equipment, labor, and services specified in SECTIONS 40 90 00 – 40 96 35. The SI shall be subcontracted and under the direct supervision of the Contractor.
 - B. Acceptable System Integrators (SI):
 - 1. The communication, instrument and control systems may use Equipment of different manufacturers, but the System Integrator Subcontractor shall assume prime responsibility for the complete instrumentation and control system.
 - 2. No Bidder shall be required to employ any Subcontractor, other person, or organization against whom Bidder has reasonable objection.
 - 3. The SI shall be one of the following companies:
 - a. Bear Automation.
 - b. Multi-Craft Contractors, Inc.
 - c. Omega Controls, Inc.

SECTION 40 90 00 – INSTRUMENTATION AND CONTROLS – GENERAL REQUIREMENTS:
continued

C. System Integrator Qualifications:

1. The instrumentation, control and communications system shall be furnished by a System Integrator (SI) who shall assume responsibility for the satisfactory performance of the complete control system . Only those SI who can demonstrate that they possess the prerequisite capabilities and experience shall be considered. The System Integrator subcontractor must meet the following minimum criteria:
 - a. The SI Company shall have been in business for a minimum of five (5) years performing SI work on water and wastewater treatment projects, and have control systems technicians with 5 years minimum experience with installation, testing, calibrating and startup of industrial control and automation systems.
 - b. The SI Company shall have specific training and experience with the following:
 - (1) Wonderware, Intouch and Intouch for System Platform, including Terminal Services.
 - (2) Wonderware, Historian software.
 - (3) Schneider Electric, Modicon M340 series of Programmable Automation Controllers and associated Unity programming software.
 - (4) Ethernet network setup and configuration including managed switch configuration.
 - (5) Instrumentation setup and calibration.
 - c. The SI shall be capable of providing control panels produced in a UL 508 authorized manufacturing facility and listed accordingly.

1.07 SEQUENCING AND SCHEDULING:

- A. Coordinate the installation of Equipment and Materials specified in this DIVISION with construction schedule.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Products as specified in SECTIONS 40 90 00 – 40 96 35.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify site conditions are suitable for installation of equipment and systems specified in this Division.

3.02 INSTALLATION:

- A. System Integrator shall be responsible for all cabling terminations at instruments, control panels and devices supplied by the System Integrator.
- B. Refer to SECTION 26 05 19 for additional cable termination requirements.

3.03 FIELD QUALITY CONTROL:

- A. Manufacturer's field services:
 1. As specified in each applicable Section, this Division.
- B. Field Testing:
 1. General Requirements:
 - a. Conform to requirements as specified in DIVISION 01.

SECTION 40 90 00 – INSTRUMENTATION AND CONTROLS – GENERAL REQUIREMENTS:
continued

- b. Conduct all tests in the presence of Engineer under the supervision of Equipment manufacturer's field engineer.
 - c. Notify Engineer two weeks prior to the commencement of all tests.
 - d. Include all tests recommended by the Equipment manufacturer unless specifically waived by Engineer.
 - e. Include all additional tests recommended by Engineer that he deems necessary because of field conditions, to determine that Equipment and Materials and systems meet requirements of Contract Documents.
 - f. Be responsible for all damage to Equipment and Materials due to improper test procedures or test apparatus handling.
2. Test Reports:
- a. Submit test reports as specified in DIVISION 01.
 - b. Maintain a written record of all tests showing date, personnel making tests, equipment or material tested, tests performed, and results.

3.04 TRAINING:

- A. The System Integrator shall provide formal training for operators, maintenance and service personnel.
- B. A training schedule and log shall be developed. The training schedule shall identify scheduled dates and times for all training sessions specified in this DIVISION. The training log shall identify dates for training and record training session attendees.
- C. Training sessions shall be scheduled with the Owner a minimum of two weeks prior to occurrence and a training schedule shall be maintained and communicated to the Owner on a routine basis.
- D. Owner may videotape all on-Site training for future use. Any charges for this videotaping shall be included.
- E. Provide training as specified in each applicable Section, this DIVISION.

END OF SECTION 40 90 00

SECTION 40 91 00 – INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this SECTION.
- 1.02 SUMMARY:
- A. This SECTION includes the requirements for measuring and controlling instruments.
- 1.03 RELATED REQUIREMENTS:
- A. SECTION 40 95 13 – Process Control Panels and Hardware.
- 1.04 REFERENCE STANDARDS:
- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 – Pipe Flanges and Flanged Fittings.
 - B. International Society of Automation (ISA):
 - 1. S20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - C. National Electrical Manufacturers Association (NEMA).
 - D. National Sanitation Foundation (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.
 - C. Product Data: Submit for each type of product specified and included the following as minimum:
 - 1. Individual specifications and technical data for instruments and similar major system components to conform to ISA S20.
 - 2. Electrical and mechanical connection diagrams for all instruments.
 - 3. Physical dimensions for each instrument.
 - D. Special Procedure Submittals:
 - 1. Test Plan:
 - a. Provide a complete and detailed calibration and test plan for the supplied instrumentation.
 - b. Include procedures for certification, validation, and testing.
 - 2. Syllabus for Owner training.
 - E. Test and Evaluation Reports:
 - 1. Factory test and calibration reports.
 - 2. Field test and calibration reports.
 - F. Closeout Submittals: Final documentation shall include the following as minimum:
 - 1. Operation and Maintenance Manuals including the following:
 - a. Operation and maintenance manuals for all instruments furnished.
 - b. Copies of all approved Product Data.
 - c. Copies of all approved Test and Calibration Reports.
 - d. Spare parts and supply list.
 - e. Warranty Information.
 - f. Contractor Information.

SECTION 40 91 00 – INSTRUMENTATION FOR PROCESS SYSTEMS: continued

- G. Maintenance Material Submittals:
 - 1. Spare Parts:
 - a. Provide five (5) spare fuses of each type used.
 - b. Provide any cabling and serial to USB converters necessary to setup and calibrate supplied instrumentation from a laptop computer.
 - 2. Software:
 - a. Manufacturer supplied software required for setup and calibration of instrumentation shall be provided.
 - b. Organize and submit all software copies in a 3-ring binder.
- 1.06 QUALITY ASSURANCE:
- A. Factory Tests:
 - 1. As a minimum, the manufacturer's standard tests and calibration procedures shall be conducted on all instruments.
- 1.07 DELIVERY, STORAGE, AND HANDLING:
- A. Instrumentation and associated equipment shall be packaged and shipped to the project site to avoid damage.
 - B. All instrumentation shall be stored according to the manufacturer's instructions.
- 1.08 WARRANTY:
- A. Instruments shall be provided with a minimum 1-year manufacturer's warranty.
 - B. In the event a component or instrument fails to perform as specified or is proven defective during the warranty period, the manufacturer shall promptly repair or replace the defective part at no cost to the Owner.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Ultrasonic Level Transmitters:
 - 1. Siemens.
 - B. Indicators:
 - 1. Endress+Hauser, Inc.
 - 2. Newport Electronics, Inc.
 - 3. Omega Engineering, Inc.
 - 4. Precision Digital Corporation.
 - 5. Red Lion Controls, Inc.
- 2.02 INSTRUMENTS:
- A. Refer to the instrument list at the end of this SECTION for a list of instruments specified to be provided by this Division.
 - B. Refer to DIVISION 46 for instruments to be provided with packaged equipment.
- 2.03 GENERAL:
- A. Transmitters shall have an output signal of 4 to 20 mA dc into a minimum load range of 0-600 ohms at 24Vdc.
 - B. All analog indicating and recording receivers shall have evenly graduated scales.

SECTION 40 91 00 – INSTRUMENTATION FOR PROCESS SYSTEMS: continued

- C. Provide all mounting brackets, pipe stands and accessories required to install all field mounted instruments. All mounting brackets and hardware for instruments installed in exterior locations or within process areas shall be stainless steel.
- D. Furnish and install all accessories required for complete and working systems as specified and indicated.
- E. Provide sun shades for all exterior mounted transmitters.
- F. All flanged instruments shall comply with ASME B16.5.

2.04 ULTRASONIC LEVEL TRANSMITTERS:

- A. System shall consist of an ultrasonic transponder and a separately mounted transceiver and transmitter to measure level in the locations specified and indicated.
- B. System accuracy shall be within $\pm 1\%$ of calibrated span.
- C. Transducer:
 - 1. Shall be completely encapsulated in a PVDF housing.
 - 2. Process connection of 2-inch NPT unless required otherwise. Provide a 150lb PVDF threaded flange adapter for specified tank mounting.
 - 3. Provide a temperature sensor at the transducer housing to sense ambient temperature.
 - 4. Transducer range shall be suitable for specified application.
 - 5. Provide the cable to connect the transducer to the transmitter. Coordinate length with installing Contractor.
 - 6. Provide a sun shield over transducers exposed to direct sunlight.
- D. Transceiver and Transmitter:
 - 1. Microprocessor based digital design.
 - 2. Provide temperature compensation to correct for speed variations of the ultrasonic signal due to air temperature changes.
 - 3. Field calibration of zero and span shall be accomplished by keypad.
 - 4. Provide a linear 4-20mA output signal proportional to level of material.
 - 5. Shall have an integral display.
 - 6. Enclosure shall be rated NEMA 4X.
 - 7. Shall have the capability to map out obstructions in the beam path. Provide additional software when required.
 - 8. Shall operate from 120Vac, 60-hertz.
 - 9. Enclosures installed outdoors shall have a thermostatically controlled strip heater to prevent condensation.
- E. Provide Siemens MultiRanger or Engineer approved equal.

2.05 FLUORIDE ANALYZER:

- A. The fluoride analyzer shall employ an ion-selective electrode method of measurement using TISAB reagent.
- B. The analyzer shall be capable of measuring fluoride every 4.2 minutes.
- C. Measured results shall be displayed by a three digit LCD readout in the range of 0.1 to 10 mg/L.
- D. The analyzer shall be designed for 30-days unattended operation.
- E. The analyzer shall operate with a lanthanum fluoride crystal.
- F. The instrument shall provide a minimum fluoride detection limit of 0.10 mg/L or better, repeatability of $\pm 7\%$ or 0.07 ppm, and accuracy better than $\pm 10\%$ or 0.10 ppm.
- G. The analyzer shall be microprocessor-controlled and provide a 4-20 mA analog signal.
- H. Analog output span minimum and maximum values shall be operator programmable at the menu-driven keypad over the entire operating range.

SECTION 40 91 00 – INSTRUMENTATION FOR PROCESS SYSTEMS: continued

- I. The analyzer shall include two programmable SPDT relays with contacts rated 5A @ 240Vac for warning or alarm.
 - 1. Each alarm shall be user-selectable for sample concentration (high or low), analyzer system warnings, or analyzer system errors.
 - 2. Concentration alarms shall be adjustable through the entire range.
- J. The microprocessor shall provide self-diagnostic functions accessible through an alphanumeric, menu-driven keyboard.
- K. The fluoride analyzer shall be housed in an IP-62 rated, ABS plastic enclosure designed for wall mounting.
- L. The enclosure shall have two clear polycarbonate windows for viewing the measurement readout and reagent levels.
- M. 1/4-inch sample connection and 1/2-inch drain connection.
- N. Operate from 120V, 60 hertz. Provide with cord and plug connection.
- O. Accessories:
 - 1. Provide 1 year maintenance kit with preassembled tubing.
 - 2. Provide a supply of reagents and standards solutions adequate for 6 months of operation based on 24-hour calibration intervals.
 - 3. Provide 2 replacement Electrode Tips (fluoride lanthanum crystal).
- P. Hach Company Fluoride Analyzer Model CA610 or Engineer approved equal.

2.06 INDICATORS:

- A. Digital Panel Meters:
 - 1. 7 segment light emitting diode (LED) display.
 - 2. 0.5 inch high digits, number as specified.
 - 3. Input signal shall be 4-20 mA dc.
 - 4. Readout shall be in engineering units specified.
 - 5. A/D conversion shall be dual slope integration method.
 - 6. Zero offset and span adjustments shall be factory set as specified and shall be field adjustable.
 - 7. Shall operate from a 120Vac, 60 hertz power supply.
 - 8. Field selectable decimal point.
 - 9. Normal Mode Rejection Ratio shall be 40dB or greater at 60 hertz and Common Mode Rejection Ratio shall be 80dB or greater from dc to 60 hertz.
 - 10. Housed in a NEMA 4X panel mounted enclosure.
 - 11. Provide barrier terminal strips for external connections.
 - 12. Furnish with mounting brackets and trim strips.
- B. Large Display Process Meters:
 - 1. Seven segment LED display housed in a NEMA 4X aluminum enclosure.
 - 2. Enclosure designed for wall mounting with provisions for conduit entry.
 - 3. Minimum 2.25-inch high red digits.
 - 4. Minimum 4-1/2 digit display.
 - 5. Powered from 120Vac.
 - 6. Accuracy of $\pm 0.05\%$.
 - 7. Input signal shall be 4-20mA.
 - 8. Screw type terminal blocks.
 - 9. Provide stainless steel sunshield to protect display and to allow for daylight viewing.

SECTION 40 91 00 – INSTRUMENTATION FOR PROCESS SYSTEMS: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify site conditions are suitable for installation of instrumentation and associated equipment.

3.02 INSTALLATION:

- A. Panel Mounted Devices: As specified in SECTION 40 95 13.
- B. Field Mounted Devices:
 - 1. Install as follows:
 - a. Mount on floor or wall as required.
 - b. Mount plumb and level.
 - c. Mount on walls with bottom of box or instrument four feet above floor unless indicated otherwise and instrument case spaced at least 1/2-inch away from wall.
 - d. Install supports as specified this DIVISION.
 - e. Install floor-mounted instruments on strut support racks.
 - f. Install measuring and controlling instruments in accordance with manufacturer's written instructions.
 - g. Calibrate and setup instruments to specified ranges.
 - h. Install identification tags on all instruments.
 - 2. Connect inputs and outputs as indicated on the manufacturer's shop drawings and as follows:
 - a. Transmitters requiring electric power shall be supplied from their associated control panels.

3.03 FIELD QUALITY CONTROL:

- A. Manufacturer's field services:
 - 1. Provide a minimum of 2 hours for each instrument to supervise/inspect installation, commission, test and start-up all equipment provided.
 - 2. All equipment required for testing, start-up and performance verification shall be provided by the start-up technician.
 - 3. All travel and living expenses shall be included.
- B. Field Testing:
 - 1. Test and start-up supervision shall continue until the system is in proper operating condition as determined by Engineer.
 - 2. Provide manufacturer's supervision during Work to correct deficiencies in Equipment manufactured by them and to correct deficiencies in the installation and wiring of Equipment. Corrections shall be at no increase in the Contract Price.
 - 3. Instrument Tests and Adjustments:
 - a. Calibrate and startup measuring and controlling instruments in accordance with manufacturers recommendations.
 - b. With each system variable transmitter disconnected from its normal source of input signal, apply an input with manometer, instrument potentiometer, or other device and adjust span and zero on all instruments transmitting, receiving, or retransmitting the resulting variable current, voltage, time duration or pneumatic signal and on all final control devices. Check instruments and final control devices at several points over the instrument measuring or control device span.
 - c. Apply manually adjustable time duration or current signals directly to receivers where required to adjust zero and span and to check operation of the instrument over the measuring span.

SECTION 40 91 00 – INSTRUMENTATION FOR PROCESS SYSTEMS: continued

- d. Accurately measure variable current, voltage, time duration and pneumatic signals as required to adjust all receivers, transmitters, transducers, and final control devices.
 - e. With input signals as specified in 1 above, adjust zero and span of each controller; check operation of controller with various set points and system variable inputs; adjust controller proportional band, reset, and rate to conform to instructions from manufacturer's representative and Engineer.
 - f. Check operation of each instrument with system in actual operation.
 - g. Readjust controller settings as required to obtain desired control of the associated system variables.
4. Functional Testing of Controls:
- a. Perform before equipment is placed in service.
 - b. Include operating control system from each control point.
 - c. Completely check each annunciator point and equipment alarm.
 - d. Operate by hand all relays, pressure switches, limit switches and other system components that cannot be operated in normal manner with plant not in service.
 - e. Repeat with plant in operation.

3.04 TRAINING:

- A. Provide a minimum of 4 hours of training at the customer's facility for operations, maintenance and service personnel for each type of instrument provided.
 - 1. The training session shall include classroom discussion on the theory of operation of the equipment, as well as maintenance and service methods for the purchased equipment.
 - 2. Topics covered shall include safety, hardware layout and functions, power and control wiring, diagnostic indicators, keypad/display interface, faults, diagnostic tools, troubleshooting, and preventive maintenance.
 - 3. Hands-on training shall be provided on equipment.
 - 4. Documentation shall be provided which shall include actual manuals for the equipment and drawings and schematics of equipment supplied for this project.
- B. The Owner at their option shall be allowed to video record all training sessions for future reference.

END OF SECTION 40 91 00

CITY OF FORT SMITH, AR
LAKE FORT SMITH WTP - FLUORIDE BUILDING INSTRUMENT LIST

| INSTRUMENT TAG NUMBER | | TYPE | DESCRIPTION | FUNCTION | PROCESS CONNECTION(S) | MOUNTING | | OUTPUT | RANGE/ SET POINT | ENGINEERING UNIT | XMTR TYPE | POWER | SPECIAL NOTES |
|-----------------------|-------------|---------------------------------------|--|----------|-----------------------|-------------|-----------|--------|---------------------|------------------|-----------|--------|---------------|
| TRANSMITTER | ELEMENT | | | | | TRANSMITTER | ELEMENT | | | | | | |
| FLU-LIT-001 | FLU-LE-001 | ULTRASONIC LEVEL TRANSMITTER | FLUOROSILICIC ACID BULK TANK FLU-TNK-001 | LEVEL | FLANGE | WALL | TANK | 4-20mA | 0-10 | FEET | 4-WIRE | 120VAC | 1,2,3,4 |
| FLU-LI-001 | N/A | LARGE DISPLAY DIGITAL LEVEL INDICATOR | FLUOROSILICIC ACID BULK TANK FLU-TNK-001 | LEVEL | N/A | WALL | N/A | N/A | 0-100 | % | 4-WIRE | 120VAC | 1,2,3 |
| FLU-WIT-002 | FLU-WE-002 | WEIGHT TRANSMITTER | FLUOROSILICIC ACID DAY TANK FLU-TNK-002 | WEIGHT | N/A | WALL | ON SCALE | 4-20mA | 0-3000 | LBS | 4-WIRE | 120VAC | 5 |
| FLU-AIT-001 | FLU-AIT-001 | FLUORIDE ANALYZER | PLANT FINISHED WATER POST CLEARWELL | FLUORIDE | 1/4" TUBING | WALL | IMMERSION | 4-20mA | 0-5 | mg/L | 4-WIRE | 120VAC | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

NOTES:

1. 120VAC POWER SOURCE FOR INSTRUMENT TRANSMITTER SHALL BE SUPPLIED FROM WITHIN THE ASSOCIATED PLC CABINET.
2. PROVIDE TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) FOR INSTRUMENT.
3. PROVIDE WITH SUNSHIELD. SUNSHIELDS MAY BE COMBINED FOR GROUP MOUNTED INSTRUMENTS.
4. COORDINATE FINAL INSTRUMENT RANGE WITH ACTUAL TANK SIZE SUPPLIED.
5. INSTRUMENT PROVIDED AS PART OF THE SUPPLIED EQUIPMENT PACKAGE. COORDINATE FINAL INSTRUMENT RANGE WITH EQUIPMENT SUPPLIED.

CITY OF FORT SMITH, AR
LEE CREEK WTP - FLUORIDE BUILDING INSTRUMENT LIST

| INSTRUMENT TAG NUMBER | | TYPE | DESCRIPTION | FUNCTION | PROCESS CONNECTION(S) | MOUNTING | | OUTPUT | RANGE/ SET POINT | ENGINEERING UNIT | XMTR TYPE | POWER | SPECIAL NOTES |
|-----------------------|-------------|---------------------------------------|--|----------|-----------------------|-------------|-----------|--------|---------------------|------------------|-----------|--------|---------------|
| TRANSMITTER | ELEMENT | | | | | TRANSMITTER | ELEMENT | | | | | | |
| FLU-LIT-001 | FLU-LE-001 | ULTRASONIC LEVEL TRANSMITTER | FLUOROSILICIC ACID BULK TANK FLU-TNK-001 | LEVEL | FLANGE | WALL | TANK | 4-20mA | 0-10 | FEET | 4-WIRE | 120VAC | 1,2,3,4 |
| FLU-LI-001 | N/A | LARGE DISPLAY DIGITAL LEVEL INDICATOR | FLUOROSILICIC ACID BULK TANK FLU-TNK-001 | LEVEL | N/A | WALL | N/A | N/A | 0-100 | % | 4-WIRE | 120VAC | 1,2,3 |
| FLU-WIT-002 | FLU-WE-002 | WEIGHT TRANSMITTER | FLUOROSILICIC ACID DAY TANK FLU-TNK-002 | WEIGHT | N/A | WALL | ON SCALE | 4-20mA | 0-3000 | LBS | 4-WIRE | 120VAC | 5 |
| FLU-AIT-001 | FLU-AIT-001 | FLUORIDE ANALYZER | PLANT FINISHED WATER POST CLEARWELL | FLUORIDE | 1/4" TUBING | WALL | IMMERSION | 4-20mA | 0-5 | mg/L | 4-WIRE | 120VAC | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

NOTES:

1. 120VAC POWER SOURCE FOR INSTRUMENT TRANSMITTER SHALL BE SUPPLIED FROM WITHIN THE ASSOCIATED PLC CABINET.
2. PROVIDE TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) FOR INSTRUMENT.
3. PROVIDE WITH SUNSHIELD. SUNSHIELDS MAY BE COMBINED FOR GROUP MOUNTED INSTRUMENTS.
4. COORDINATE FINAL INSTRUMENT RANGE WITH ACTUAL TANK SIZE SUPPLIED.
5. INSTRUMENT PROVIDED AS PART OF THE SUPPLIED EQUIPMENT PACKAGE. COORDINATE FINAL INSTRUMENT RANGE WITH EQUIPMENT SUPPLIED.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This SECTION includes requirements for control panels and associated components

1.03 RELATED REQUIREMENTS:

- A. SECTION 40 90 00 – Instrumentation and Controls - General Requirements.
- B. SECTION 40 91 00 – Instrumentation for Process Systems.
- C. SECTION 40 95 33 – Process Control Networks.
- D. SECTION 40 96 35 – Process Control Software Programming and Reports.

1.04 REFERENCE STANDARDS:

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):
 - 1. C37.90.1 – Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
 - 2. C62.11 – Metal Oxide Surge Arresters for AC Power Circuits.
 - 3. C62.33 – Test Specifications for Varistor Surge-Protective Devices.
 - 4. C62.36 – Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits
 - 5. C62.41.1-2002 – Surge Environment in Low-Voltage (1000 Volts and less) AC Power Circuits.
 - 6. C62.41.2-2002 – Characterization of Surges in Low-Voltage (1000 Volts and less) AC Power Circuits.
 - 7. C62.45-2002 – Surge Testing on Equipment Connected to Low Voltage (1000 Volts and less) AC Power Circuits.
 - 8. C62.62-2010 – Test Specification for Surge Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 Volts and less) AC Power Circuits.
 - 9. IEEE 802.3 – Ethernet.
- B. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC).
- C. National Electrical Manufacturers Association (NEMA):
 - 1. 250 – Enclosures for Electrical Equipment (1,000V maximum).
 - 2. KS 1 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
 - 3. ICS 1 – Industrial Control and Systems - General Requirements.
 - 4. ICS 2 – Industrial Control and Systems - Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - 5. ICS 4 – Application Guideline for Terminal Blocks.
 - 6. ICS 5 – Industrial Control and Systems - Control Circuit and Pilot Devices.
 - 7. ICS 6 – Industrial Control and Systems - Enclosures.
- D. Underwriters Laboratories (UL):
 - 1. 50 – Enclosures for Electrical Equipment.
 - 2. 98 – Enclosed and Dead-Front Switches.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. 489 – Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
 4. 508 – Industrial Control Equipment.
 5. 508A – Industrial Control Panels.
 6. 698A – Industrial Control Panels Relating to Hazardous (Classified) Locations.
 7. 869 – Service Equipment.
 8. 1449 – Surge Protective Devices.
 9. 1778 – Uninterruptible Power Systems.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.
 - C. Product Data: Submit the following for each type of product specified and included as minimum:
 1. Data sheets for all control panel components furnished.
 - D. Qualification Statements:
 1. Fabricator’s qualifications.
 - E. Shop Drawings: Provide the following as minimum:
 1. Fabrication drawings, front elevation, wiring diagrams, and bills of material for control panels.
 2. Electrical connection diagrams showing termination locations for all field wiring. External connection diagrams shall indicate cable number and wire color for field cables terminated at the panel.
 3. Engraving schedule and physical dimensions for nameplates.
 4. Provide heat dissipation calculations for all panels containing programmable logic controllers. Include calculation for ventilation fans if required.
 - F. Special Procedure Submittals:
 1. Test Plan:
 - a. Provide a complete and detailed test plan for the supplied control panels.
 - b. Include procedures for certification, validation, and testing.
 2. Syllabus for Owner training.
 - G. Test and Evaluation Reports:
 1. Factory test reports.
 2. Field test reports.
 - H. Closeout Submittals: Final documentation shall include the following as minimum:
 1. Operation and Maintenance Manuals including the following:
 - a. Operation and maintenance manuals for all components furnished.
 - b. Certified “As-Built”/“As-Installed” drawings.
 - c. Copies of all approved Product Data.
 - d. Copies of all approved Test Reports.
 - e. Spare parts and supply list.
 - f. Warranty Information.
 - g. Contractor Information.
 - I. Maintenance Material Submittals:
 1. Spare Parts:
 - a. Five spare control fuses of each voltage and current rating used.
 - b. One aerosol cans of manufacture’s touch-up paint for each color used. Color shall match the original factory applied color.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

2. Software:
 - a. Soft copy of PLC and touchscreen programs including all programming comments.
 - b. Original CD/DVD-ROM disks and/or flash drives containing all software associated with the supplied managed Ethernet switches.
 - c. Organize and submit all software copies in a 3-ring binder.

- 1.06 QUALITY ASSURANCE:
 - A. Materials and Equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to Bid opening.
 - B. Fabricator Qualifications:
 1. Prior to assembly and installation, submit data of fabricator's experience and qualifications.
 2. Fabrication shall be by a manufacturer or a particular division of a manufacturing firm specializing in control panel construction.
 3. Shall have a minimum of 10 years experience in control panel fabrication.
 4. Panel shall be fabricated in a UL listed panel shop.
 - C. Factory Tests:
 1. The manufacturer shall conduct tests according to industry standard requirements.
 2. Perform factory tests on all control panels and components and subassemblies to assure that all devices and systems are in proper working order before delivery to jobsite.
 3. Test all power, control and communication systems for proper operation.
 4. Simulate actual system operation.
 5. Submit test reports as specified in DIVISION 01.

- 1.07 DELIVERY, STORAGE, AND HANDLING:
 - A. Control panels and associate equipment shall be packaged and shipped to the project site in such a manner as to avoid damage.
 - B. All control panels shall be stored according to the manufacturer's instructions and in a conditioned space to avoid condensation, dust, and other environmental contaminants.

- 1.08 PROJECT SITE CONDITIONS:
 - A. Do not store or install the control panel equipment specified herein until designated installation spaces are suitable for intended service.
 - B. For indoor control panels final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to energizing panel and shall be maintained for the remainder of the construction period.

- 1.09 WARRANTY:
 - A. Surge Protective Devices shall be provided with a minimum 5-year manufacturer's warranty.
 - B. Ethernet switches shall be provided with a minimum 5-year manufacturer's warranty.
 - C. All other equipment shall be provided with a minimum one-year warranty period.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
 - A. Enclosures:
 1. B-Line, Eaton.
 2. Hoffman, Pentair PLC.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Wiegmann, Hubbell, Inc.
4. Milbank Manufacturing Company.
5. Saginaw Control & Engineering.
- B. Circuit Breakers:
 1. Acme Electric.
 2. Allen-Bradley, Rockwell Automation, Inc.
 3. Cutler-Hammer, Eaton.
 4. General Electric Company.
 5. Phoenix Contact.
 6. Square D, Schneider Electric.
- C. Surge Protective Devices:
 1. Advanced Protection Technologies, Inc.
 2. Citel, Inc.
 3. EDCO, Emerson Electric Company
 4. Ferraz Shawmut, Mersen.
 5. MCG Surge Protection, Inc.
 6. MTL Instruments, Eaton.
 7. Phoenix Contact.
 8. Square-D, Schneider Electric.
- D. Terminal Blocks:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. Buchanan, Tyco Electronics Corporation.
 3. Phoenix Contact.
 4. Square-D, Schneider Electric.
 5. Weidmuller.
- E. Push buttons, Selector Switches and Pilot Lights:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. Appleton, Emerson Electric Company.
 3. Cutler-Hammer, Eaton.
 4. IDEC Corporation.
 5. Killark, Hubbell, Inc.
 6. Square-D, Schneider Electric.
- F. Control and Timing Relays:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. Cutler-Hammer, Eaton.
 3. IDEC Corporation.
 4. Phoenix Contact.
 5. Potter & Brumfield, Tyco Electronics Corporation.
 6. Square-D, Schneider Electric.
 7. Turck, Inc.
- G. DC Power Supplies:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. IDEC Corporation.
 3. Phoenix Contact.
 4. SolaHD, Emerson Electric Company.
- H. Convenience Receptacles:
 1. Cooper Industries, Eaton.
 2. Hubbell, Inc.
 3. Leviton Manufacturing Co., Inc.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- 4. Phoenix Contact.
- I. Interior Illumination:
 - 1. Acuity Brands, Inc.
 - 2. Hoffman, Pentair Inc.
 - 3. Hubbell, Inc.
 - 4. Stego, Inc.
- J. Programmable Logic Controllers (PLC):
 - 1. Schneider Electric.
- K. Operator Interface Touchscreen:
 - 1. Schneider Electric.
- L. Ethernet Switches:
 - 1. Refer to SECTION 40 95 33 – Process Control Networks.
- M. Wiring Duct:
 - 1. Panduit Corporation, H-Type.
- N. Wire Markers:
 - 1. Brady Worldwide, Inc.
 - 2. Panduit.
 - 3. Thomas and Betts Corporation, ABB Group.

2.02 ENCLOSURES:

- A. Totally enclosed panel with gasketed doors, continuous hinge, and three point latching mechanism with lockable handle.
- B. Sized to house all equipment and devices required, provide sufficient space for conduit entry, and provide sufficient heat dissipation for the installed components.
- C. Unless specified or indicated otherwise provide the following enclosure type:
 - 1. NEMA Type 4X stainless-steel enclosure for outdoor and chemical feed locations.
 - 2. NEMA Type 12 painted steel enclosures for indoor electrical rooms.
- D. Unless specified or indicated otherwise provide the following enclosure design:
 - 1. Wall Mount Design:
 - a. Provide for enclosures with a vertical dimension less than 50-inches.
 - b. Formed and welded construction, minimum 14-gauge.
 - c. Interior 12-gage minimum steel mounting panel(s).
 - d. Provide mounting tabs and required hardware for installation of enclosures.
 - 2. Free Standing Design:
 - a. Provide for enclosures with vertical dimensions of 50-inches or greater.
 - b. Formed and welded construction, minimum 12-gauge for single door enclosures and 10-gauge for multi-door enclosures.
 - c. Interior 12-gage steel mounting panel(s)
 - d. Provide door mounted folding shelf for support of instruments and test equipment. Shelf shall be mounted on the interior of the door. For multi-door enclosures provide a shelf for each pair of doors.
 - e. Provide with lifting eyes.
- E. Provide lockable design.
- F. Painted enclosures shall have a light gray polyester powder coat finish on the exterior with a white polyester powder coat finish on the interior.
- G. Accessories:
 - 1. Provide data pocket mounted on the interior of the panel for storage of wiring diagrams.
 - 2. Provide vapor action corrosion inhibitor emitters for each panel. Emitters shall be provided as a minimum based upon twice the calculated volume of the enclosure.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Provide a door stop kit designed to secure the door in the 90 degree open position.
- 2.03 NAMEPLATES:
- A. Fabricate from laminated phenolic sheeting with black core and satin finish melamine overlay.
 - B. Colors shall white with black letters.
 - C. Thickness: 1/16 inch nominal.
 - D. Bevel edges to expose black core on perimeter.
 - E. Engraved legend through overlay to expose core.
 - F. Attach to panels with industrial grade double-faced tape.
- 2.04 CIRCUIT BREAKERS:
- A. 120/240Vac and 24Vdc:
 1. Provide for main disconnecting means for panel and for power distribution within the panel as indicated.
 2. Rated for 120/240Vac and 24Vdc as indicated.
 3. Thermal-magnetic trip units.
 4. Trip rating and curve as recommended by manufacturer of equipment being protected.
 5. DIN rail mounted on the inside of the control panel in a readily accessible location.
 6. Toggle-type handle with a quick-make, quick-break over-center switching mechanism that is mechanically trip-free.
 7. Minimum symmetrical interrupting capacity of 10,000 AIC.
- 2.05 SURGE PROTECTIVE DEVICES:
- A. 120/240V Surge Suppressors:
 1. Provide for 120V/240Vac distribution system within panel to protect electronic components from transient voltage surges.
 2. UL 1449 (3rd Edition) listed.
 3. Shall meet Type 2 SPD criteria with the following minimum protection characteristics:
 - a. I_n : 20kA (per mode)
 - b. SCCR: 100kAIC (minimum)
 - c. MCOV: 150V (L-G), 270 (L-L).
 - d. UL Voltage Protection Rating:
 - (1) L-L: 1000V
 - (2) L-N, L-G, N-G: 600V
 4. Designed for 120/240Vac, single-phase operation.
 5. EMI/RFI filtering.
 6. Peak clamping voltage of 320 volts line to neutral and 350 volts line to ground with Category B waveform.
 7. Minimum continuous series operating current rating of 20Amps.
 8. Minimum surge current capacity of 10 kA per mode (8/20 μ s).
 9. Response time of less than 25 nanoseconds.
 10. Equipped with an LED status indicator for verification that unit is functioning.
 11. NEMA 1 enclosure designed for back panel or DIN rail mounting within a control panel.
 12. Minimum five year warranty.
 13. Provide SPDT contacts for remote indication. Contacts rated 0.5A at 120Vac minimum.
 - B. Panel I/O Surge Suppressors:
 1. Provide DIN rail mounted terminal block type transient voltage surge suppressors for all inputs and outputs that are wired to devices located outside of the building envelope.
 2. Finger safe screw type terminals.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Replaceable surge modules.
 4. Three-stage surge protection.
 5. Provisions for labeling terminal block numbers.
 6. Minimum five year warranty.
 7. Analog and 24Vdc Signal Surge Protection:
 - a. Series surge suppressor.
 - b. Minimum surge current capacity of 10 kA per mode (8/20 μ s).
 - c. Minimum lightning surge current capacity of 500A per path (10/350 μ s).
 - d. Maximum let thru voltage line to ground of 45 Vdc.
 - e. Maximum let thru voltage line to line of 90 Vdc.
 - f. Response time of less than 5 nanoseconds.
 - g. Maximum series resistance of 10 ohms.
 - h. Minimum continuous current rating of 300 mA.
 8. 120Vac Discrete Signal Surge Protection:
 - a. Series surge suppressor.
 - b. Minimum surge current capacity of 4 kA per mode (8/20 μ s).
 - c. Minimum lightning surge current capacity of 2.5 kA per path (10/350 μ s).
 - d. Maximum let thru voltage line to ground 380 Vac.
 - e. Maximum let thru voltage line to line of 600 Vac.
 9. Minimum continuous current rating of 15A.
 10. Response time of less than 25 nanoseconds.
- 2.06 TERMINAL BLOCKS:
- A. 600V, sectional type polyamide blocks.
 - B. Rated a minimum of 20A. Provide higher Amp rated blocks as required.
 - C. Tubular clamp contacts.
 - D. Slide in vinyl marking strip for terminal identification.
 - E. Finger safe.
 - F. DIN rail mounted.
- 2.07 SWITCH ACTION FUSE BLOCKS:
- A. Rated 600V.
 - B. Tubular clamp contacts.
 - C. Finger safe.
 - D. DIN Rail mounted.
- 2.08 PUSH BUTTONS AND SELECTOR SWITCHES:
- A. Heavy duty, 30 mm units with contacts rated 10A continuous at 120Vac.
 - B. NEMA 4X rated when installed in NEMA 12 or 4X enclosures.
 - C. Provide the number of contacts and contact development as indicated.
 - D. Start or On push buttons shall have green operators.
 - E. Stop or Off push buttons shall have red operators.
 - F. Emergency Stop push buttons shall have red mushroom head operators.
- 2.09 PILOT LIGHTS:
- A. Heavy duty, 30 mm units.
 - B. NEMA 4X rated when installed in NEMA 12 or 4X enclosures.
 - C. 120Vac or 24Vdc cluster LED type.
 - D. Green lights shall indicate “Equipment On” or “Running”.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- E. Red lights shall indicate “Equipment Off” or “Stopped”.
 - F. Amber lights shall indicate “Equipment Failure” or “Alarm”.
 - G. Push to test type.
- 2.10 CONTROL RELAYS:
- A. Plug-in type relay with neon coil energization indicator.
 - B. Coil voltage: 120Vac or 24Vdc as required.
 - C. Contacts rated 10 Amps at 120Vac.
 - D. Number of contacts as required.
 - 1. Provide one spare N.O. and one spare N.C. contact (minimum).
 - E. Provide DIN rail mounted relay socket with screw type terminations.
- 2.11 TIME DELAY RELAYS:
- A. Plug-in type digital based electronic timing relay with coil energization indicator.
 - B. Coil voltage: 120Vac or 24Vdc as required.
 - C. Contacts rated 10 Amps at 120Vac.
 - D. Timing range as indicated with a minimum setting accuracy of $\pm 2\%$ and repeat accuracy of $\pm 0.1\%$.
 - E. The selection of timing range settings via DIP switches. The time delay within the range shall be set utilizing an adjustment dial.
 - F. Number of contacts as required.
 - 1. Provide one spare N.O. and one spare N.C. contact (minimum).
 - G. Provide DIN rail mounted relay socket with screw type terminations.
- 2.12 DC POWER SUPPLIES:
- A. Provide industrial rated primary switched 24Vdc power supplies as specified and indicated.
 - B. Enclosed design with finger safe input and output terminal blocks.
 - C. Designed for DIN rail or back panel mounting.
 - D. DC power supply rated as follows:
 - 1. Input voltage: 95 to 130Vac.
 - 2. Output voltage: 24Vdc $\pm 1\%$.
 - 3. Output current: 10A minimum with a minimum 25% spare capacity.
 - 4. Line regulation: $\pm 0.2\%$ maximum.
 - 5. Load regulation: $\pm 1.5\%$ maximum.
 - 6. Ripple: < 50 mV pk-pk.
 - 7. No overshoot for turn on, turn off, or power failure.
 - 8. Operating temperature: -25°C to $+60^{\circ}\text{C}$.
 - 9. Overload and short circuit protection.
 - 10. Indicating lights for status.
 - E. DC UPS System:
 - 1. Provide DC power supplies equipped with a UPS System for the following control panels:
 - a. Control Panels with PLCs installed.
 - 2. Shall charge and monitor the battery.
 - 3. Shall automatically switch without interruption to battery power if the primary 120Vac source is lost and switch back automatically to the 120Vac source when power is restored.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

4. The UPS system shall utilize maintenance free lead-acid batteries rated to provide a minimum of 15 minutes of backup time for the connected load with a minimum size of 7Ah.
 5. Provide a support rack for the batteries designed for DIN rail or back panel mounting.
 6. Equipped with a resettable over current protection to protect the batteries.
 7. The batteries shall be field replaceable.
 - a. The unit shall be equipped with an on/off switch to bypass the battery system and allow for replacement of the batteries while the power supply is in operation.
 8. The system shall provide relay outputs rated a minimum of 0.25A at 24Vdc to indicate the following:
 - a. AC Power Failure.
 - b. Low Battery/Common Alarm.
- 2.13 CONVENIENCE RECEPTACLES:
- A. DIN rail mounted, 15-A duplex three-wire grounding GFCI type outlet with enclosure.
 - B. Equipped with terminal blocks for power connection.
 - C. Outlet shall be protected with a 5 Amp circuit breaker.
 - D. One mounted inside control panel for use in powering laptops and test equipment for service of the panel.
- 2.14 INTERIOR ILLUMINATION:
- A. Provide LED type panel lights.
 - B. Minimum 50,000 hour life.
 - C. Provide a minimum 50 footcandles at the base of the panel
 - D. Powered from 120Vac. Provide required power supply.
 - E. Door interlocked switch.
- 2.15 PANEL MOUNT ETHERNET SWITCHES:
- A. Provide Ethernet switches as indicated and specified. Refer to SECTION 40 95 33 – Process Control Networks for requirements.
- 2.16 PROGRAMMABLE LOGIC CONTROLLERS (PLC):
- A. Provide Modicon M340 PLCs with a central processing unit capable of communicating on Modbus TCP network.
 1. General:
 - a. The programmable controller shall receive status intelligence, perform logic functions, issue control commands, and provide alarms and status information for the systems described in these Specifications.
 - b. The PLC shall support the following programming languages:
 - (1) Relay ladder
 - (2) Structured text
 - (3) Function block
 - (4) Sequential function charts
 - c. The programmable controller Equipment shall consist of a solid-state control system which has user programmable memory for storage of instructions to implement specific functions.
 - d. The PLC Equipment shall be purposely designed as an industrial control system which can perform functions equivalent to a relay panel or a wired solid-state logic system.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- e. All PLC Equipment provided shall be capable of operation in ambient temperatures of 0°C to 60°C, and 5 to 95% relative humidity (non-condensing), without fans or other cooling equipment.
- f. All external connection points shall be capable withstanding the ANSI surge withstand capability (SWC) test as defined in ANSI/IEEE C37.90.1.
- g. The PLC's shall be capable of being configured as a redundant controller.
- 2. Chassis:
 - a. Provide PLC chassis as required to accommodate the I/O and communications modules required and indicated.
 - b. Provide slot fillers for all unused chassis spaces.
- 3. Power Supplies:
 - a. Provide power supplies for the processor chassis as required.
 - b. Input voltage shall be 24Vdc and provide a minimum of 31 watts of power.
 - c. Power supply model number BMXCPS3020.
- 4. Processor:
 - a. The processor shall be a Modicon model BMXP342020. (Modbus Serial and Ethernet Modbus TCP).
 - b. The processor shall be of solid-state design on modular printed circuit boards.
 - c. The processor shall be equipped with two communication ports an Ethernet Modbus TCP/IP type RJ-45 and a Modbus Serial communication port for programming and communication of data.
 - d. The processor shall include an integrated USB port, 12Mbit/s.
 - e. The processor shall have user-programmable memory with provisions to prevent unauthorized changes.
 - f. The processor shall be equipped with a minimum of 4 Mbytes of user memory. Additional memory shall be provided if required to perform the functions specified.
 - g. Nonvolatile flash memory card shall be provided for storage of the PLC program.
 - h. The processor shall continuously perform diagnostics analysis with a predetermined failure mode in the event of a fault.
 - i. The ladder diagram logic shall be scanned and solved at a rate not to exceed one (1) milliseconds per kiloword of logic.
 - j. All I/O including analog shall be scanned and updated at a rate not to exceed 0.3 milliseconds for all I/O.
 - k. The ladder logic programming shall include support for subroutines.
 - l. The processor shall include a real time clock and calendar accessible for use by the user program.
 - m. The processor shall have at least two (2) operating modes: Run and Program. These operating modes shall be user changeable via front panel switches and over the PLC communications network.
 - n. The processor shall allow the logic to be modified, in ladder logic format, while the processor is in the Run mode without affecting the operation of those portions of the logic not being modified.
 - o. The processor shall allow disabling and forcing on and off of individual input and output when the processor is in the Run mode.
 - p. The processor shall provide selectable timed interrupt capabilities for the user to incorporate into the ladder logic.
 - q. The processor shall provide user defined fault routine capabilities.
 - r. The processor shall automatically clear all output and update all input on power-up and prior to scanning and solving any logic.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- s. The processor shall provide the user with a status bit for use in the ladder logic for initialization purposes. This status bit shall be set/reset based on the indicating the first ladder logic scan.
- t. The processor shall provide a comprehensive instruction set including:
 - (1) Relay Contact Input:
 - (a) Normally open.
 - (b) Normally closed.
 - (c) Transitional.
 - (2) Relay Coil Output:
 - (a) Standard.
 - (b) Retentive.
 - (3) Timers:
 - (a) On delay.
 - (b) Off delay.
 - (c) Duration.
 - (d) Retentive
 - (e) Time bases of 1.0 sec, 0.1 sec, and 0.01 sec.
 - (4) Counters:
 - (a) Count up.
 - (b) Count down.
 - (5) Arithmetic:
 - (a) Single-precision.
 - (b) Double-precision.
 - (c) Integer.
 - (d) Add.
 - (e) Subtract.
 - (f) Multiply.
 - (g) Divide.
 - (h) Square root.
 - (i) Less than.
 - (j) Greater than.
 - (k) Equal.
 - (6) Logical:
 - (a) And.
 - (b) Or.
 - (c) Exclusive or.
 - (d) Compare.
 - (7) PID.
- 5. PLC Input and Output Modules:
 - a. Digital input modules shall be 16 point, 24Vdc model number BMXDDI1602.
 - b. Digital output modules shall be 16 point 24Vdc model number BMXDDO1602.
 - c. Analog input modules shall be 4 point, multi-range, isolated model number BMXAMI0410.
 - d. Analog output modules shall be 4 point, multi-range, isolated model number BMXAMO0410.

2.17 OPERATOR INTERFACE TOUCHSCREEN (OIT):

- A. Provide for PLC cabinets where indicated and specified.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- B. Provide a 10” flat panel color TFT display (16-bit color, minimum). Resolution shall be 640x480 minimum.
- C. Luminance shall be a minimum of 300 cd/m² (Nits) with a field replaceable backlight.
- D. Display unit shall have a minimum of 96MB flash EPROM and 512kB internal RAM.
- E. Environmental operating temperature range shall be 0 to 50°C, at 5 to 95% non-condensing relative humidity.
- F. Shall be panel mounted with a NEMA rating to match the associated enclosure rating.
- G. Provide the following external ports and interfaces as minimum:
 - 1. One SD Card (SDHC), Include compatible 32GB SD card.
 - 2. One USB-2.0 ports.
- H. Communication interfaces shall include the following as minimum:
 - 1. One RJ-45 Ethernet (10/100 Mb Autosensing).
 - 2. One RS232 Serial Port (DB9).
- I. Shall accept input power from 24VDC supply.
- J. Shall be capable of communicating over the Modbus TCP network as indicated.
- K. Provide Magelis HMIGTO5315 or Engineer approved equal.

2.18 PLC I/O:

- A. Refer to the I/O Lists at the end of SECTION 40 96 35 – Process Control Software Programming and Reports for a list of I/O required to be provided for the plant control system.

2.19 ELECTRICAL SYSTEM:

- A. Wiring:
 - 1. UL style 1015, machine tool wire (MTW), 600V, 90°C.
 - 2. No. 14 AWG, 19 strand, for all control wiring.
 - 3. No. 18 AWG, shielded twisted pairs for all instrumentation wiring.
 - a. Color code shall be black/red pair with black (blue) PVC jacket.
 - 4. Wire Colors:
 - a. Black: un-switched, ungrounded AC wiring.
 - b. Red: switched, ungrounded AC wiring.
 - c. White: AC neutral.
 - d. Green: ground.
 - e. Blue: DC(+).
 - f. White w/ Blue Tracer: DC(-) grounded.
- B. Wire Markers:
 - 1. Heat shrinkable, tube-type sleeve markers, constructed of polyolefin material.
 - 2. White sleeves with black thermal printed text.
 - 3. Identify both ends of wire with the same unique wire number.
 - 4. Assign wire numbers where specific designations are not indicated.
 - 5. Markers sized for snug fit for wire size.
- C. Wiring Duct:
 - 1. Provide wide slot wiring duct in panel for routing of panel wiring. Slots shall be a minimum of 0.25-inches.
 - 2. Provide with dual hinge, push-on cover that opens a minimum of 100 degrees to either side.
 - 3. Wiring ducts shall be sized to accommodate all installed wire plus a minimum of 25% spare capacity.
- D. Ground Bus:
 - 1. Provide isolated copper ground bus.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

2.20 ARC FLASH LABEL:

- A. Provide a 6 x 4 inch (minimum), plastic arc flash label for each control panel.
- B. Label shall be orange and white.
- C. Label shall read as follows: WARNING – Arc Flash and Shock Hazard. Appropriate PPE and Tools Required When Working on this Equipment.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify site conditions are suitable for installation of equipment.
- B. For indoor control panels final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to energizing panel and shall be maintained for the remainder of the construction period.

3.02 PANEL FABRICATION:

- A. Install all components in the panel as required and recommended by the manufacturer.
- B. Provide master nameplate and nameplates for all operator interfaces. Interior nameplates shall be provided for individual component identification including, but not limited to, power supplies, PLCs, control relays, terminal blocks, Ethernet switches, circuit breakers, etc.
- C. Provide interior illumination for all panels equipped with a PLC.
- D. Power Distribution:
 - 1. Provide circuit breakers for protection of equipment in the panel and distribution of power to equipment powered from the control panel.
 - 2. Provide 120Vac circuit breakers to distribute power within the control panel. Circuit breakers shall be sized based upon connected load. As a minimum, dedicated circuit breakers shall be provided for the following:
 - a. Incoming power sources.
 - b. Each device such as lights, fans, heaters, receptacles installed within the panel.
 - c. PLC power supplies (120Vac).
 - d. 24Vdc power supplies.
 - e. Each 120Vac digital input or output module.
 - f. Each 120Vac instrument or device powered from the panel.
 - 3. Provide 24Vdc circuit breakers to distribute power within the control panel. Circuit breakers shall be sized based upon connected load. As a minimum dedicated circuit breakers shall be provided for the following:
 - a. Output of 24Vdc power supply.
 - b. PLC power supply (24Vdc).
 - c. Each 24Vdc digital input or output module.
 - d. Each loop powered instrument.
 - e. Each analog input module, if required.
 - f. Each analog output module, if required.
 - g. Each 24Vdc instrument or device powered from the panel.
 - 4. Provide signage on panel to clearly indicate that the panel is powered from multiple sources if applicable.
- E. Surge Protection:
 - 1. Provide surge protection on 120Vac distribution systems within the panel to protect electronic components from transient voltage surges.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

2. Provide surge protection on all power circuits to instruments installed outside of the building envelope in which the control panel is installed. The terminal block type surge suppressor shall be the termination point for the field cabling.
 3. Provide surge protection on all inputs and outputs that are connected to equipment outside of the building envelope in which the control panel is installed. The terminal block type surge suppressor shall be the termination point for the field cabling.
- F. Component Mounting:
1. Operator interfaces and indicating lights shall be installed in the door of the panel at a convenient height for operator interaction.
 2. Components shall be mounted to provide complete accessibility to all terminals, relay sockets, and other devices without dismantling of panel equipment.
 3. Provide sufficient space around and layout components to allow for proper heat dissipation.
 4. Provide sufficient space at the top and bottom of the panel for conduits and cable entry. Conduit entry locations shall be coordinated with the installing Contractor.
- G. PLC I/O:
1. Provide interposing relays for all discrete outputs from the PLC including spare points.
 2. Wire all inputs and outputs from the PLC to terminal blocks.
- H. Wiring Methods:
1. Route main groups of wires in plastic nonflammable wiring duct.
 2. Smaller groups of wire shall be cabled and secured with nylon cable clamps and ties or plastic spiral wraps.
 3. Maintain physical separation of power, control and instrumentation cables within the panel.
 4. Provide dedicated wiring ducts for management of field cables within the panel. Wiring ducts shall be sized to accommodate multi-conductor control cables. Assume a minimum of 25% spare conductors and provide a minimum of 25% spare capacity when sizing wiring ducts.
- I. Terminal Blocks and Connections:
1. Provide terminal blocks for all external connections.
 2. Make all connections on terminal blocks.
 3. Follow manufacturer's recommendations for terminal block installation.
 4. Connect terminal blocks for instrumentation cable shields to isolated ground bus.
 5. Provide required grounding type terminal blocks.
- J. Spare Capacity:
1. Provide a minimum of 20 percent or 1 circuit breakers, whichever is greater, for each power source (Vac and Vdc) present within the panel. All spare circuit breakers shall be mounted, wired, and include provisions to terminate associated neutral or negative conductors.
 2. Provide a minimum of 2 spare slots in each PLC chassis. Provide blank filler modules for all empty slots.
 3. Provide a minimum of 20 percent spare PLC inputs and outputs for each type in each panel. All spare points shall be wired to field terminal blocks.
 4. Provide a minimum of 20 percent spare terminal blocks of each type mounted in the panel.
 5. Provide spare DIN rail space for the installation of terminal blocks for all spare slots in the PLC chassis plus 20%.
- K. Provide labeling on all terminal blocks, wiring and relays to match panel drawings.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3.03 UNITERRUPTIBLE POWER SUPPLY INSTALLATION:

- A. A DC power supply with a UPS system shall be provided and installed for each panel containing a PLC.
- B. Status contacts shall be wired to the PLC for remote monitoring.

3.04 ETHERNET SWITCH INSTALLATION:

- A. Install Ethernet switches in control panels and make connections as indicated.
- B. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
- C. Shall provide adequate ports for connection to the plant control system, PLC, touchscreen and provide a minimum of one spare programming port.

3.05 PLC PROGRAMMING:

- A. Refer to SECTION 40 96 35 – Process Control Software Programming and Reports for PLC programming requirements.
- B. The PLC shall be programmed to perform the required logic for proper operation of the equipment.
- C. The PLC program shall be thoroughly documented with explanations in the program of the operation performed in each program line or rung.
- D. The PLC shall monitor power status to the control panel. Logic shall be implemented that shall clear run contacts when power is lost and perform routine startup of equipment after a power restoration.
- E. Control and status points specified to be communicated with the plant control system shall be tagged as specified and indicated and shall be organized to provide efficient communication with the plant control system.
- F. Shall be programmed utilizing the version of Unity programming software currently in use for the existing PLCs. Coordinate version with Owner for each project site.
- G. Soft copy of the program shall be provided to the Owner.

3.06 TOUCHSCREEN PROGRAMMING:

- A. The touchscreen shall be programmed to provide required operator interfaces with the chemical metering equipment and associated ancillaries of the fluoridation facilities.
- B. Shall be programmed utilizing the latest version of Windows based programming software from the manufacturer.
- C. Screens shall be laid out in a logical order with a main overview screen and links from each screen back to the main overview screen.
 - 1. Operator adjustable set points shall be password protected.
- D. The screen layout and graphics used for the touchscreen interface shall match those developed for the plant control system Wonderware screens.
- E. The color green shall indicate “Equipment On” or “Valve Open” and red shall indicate “Equipment Off” or “Valve Closed”.
- F. Store a copy of the final HMI program on the OIT SD card.
- G. Both a hard and soft copy of the final application shall be provided to the Owner.

3.07 INSTALLATION:

- A. Control Panels:
 - 1. Conform to manufacturer’s written instructions.
 - 2. Surface-mount wall mount enclosures on structural supports or wall approximately 4 feet to center line above the floor when possible.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Install floor mounted enclosures where indicated and bolt to floor using expansion type concrete anchors.
 4. Install all necessary openings in panels.
 5. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
 6. Mount plumb and level.
 - B. Electrical Connections:
 1. Install wire and cable as specified in DIVISION 26.
 2. Conform to manufacturer's wiring diagrams.
 3. Install circuits to field-mounted equipment as indicated and required.
 - C. Place arc flash label on equipment.
- 3.08 FIELD QUALITY CONTROL:
- A. Manufacturer's Field Services:
 1. The panel supplier shall provide the field services of a trained technician for the amount of time required to commission, test and start-up all equipment provided.
 2. All travel and living expenses shall be included for all trips to the site. All equipment required for testing, start-up and performance verification shall be provided by the start-up technician.
 - B. Check all internal and external connections and tighten as required.
 - C. Perform I/O checkout on all points and verify proper operation.
 - D. Verify proper connection of communication cabling and proper communication system configuration.
 - E. Field verify proper operation of all inputs and outputs.
 - F. Record results of I/O checkout and submit test reports as specified in DIVISION 01.
- 3.09 ADJUSTING AND CLEANING:
- A. After field installation and final wiring terminations are completed the control panel wiring and cables shall be adjusted and neatly secured with tie wraps, hook-and-loop straps, or the like.
 - B. Wiring duct covers shall be replaced and secured as required.
 - C. Prior to final acceptance control panel interior and exterior shall be wiped clean and free from dust and debris.
- 3.10 TRAINING:
- A. Provide a minimum of 4 hours of training for each panel provided at the customer's facility for operations, maintenance and service personnel.
 1. The training session shall include classroom discussion on the theory of operation of the equipment, as well as maintenance and service methods for the purchased equipment.
 2. Topics covered shall include safety, hardware layout and functions, power and control wiring, diagnostic indicators, keypad/display interface, faults, diagnostic tools, troubleshooting, and preventive maintenance.
 3. Hands-on training shall be provided on equipment.
 4. Documentation shall be provided which shall include actual manuals for the equipment and drawings and schematics of equipment supplied for this project.
 - B. The Owner at their option shall be allowed to video record all training sessions for future reference.

END OF SECTION 40 95 13

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this SECTION.
- 1.02 SUMMARY:
- A. This SECTION includes requirements for control panels and associated components
- 1.03 RELATED REQUIREMENTS:
- A. SECTION 40 90 00 – Instrumentation and Controls - General Requirements.
 - B. SECTION 40 91 00 – Instrumentation for Process Systems.
 - C. SECTION 40 95 33 – Process Control Networks.
 - D. SECTION 40 96 35 – Process Control Software Programming and Reports.
- 1.04 REFERENCE STANDARDS:
- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):
 - 1. C37.90.1 – Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
 - 2. C62.11 – Metal Oxide Surge Arresters for AC Power Circuits.
 - 3. C62.33 – Test Specifications for Varistor Surge-Protective Devices.
 - 4. C62.36 – Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits
 - 5. C62.41.1-2002 – Surge Environment in Low-Voltage (1000 Volts and less) AC Power Circuits.
 - 6. C62.41.2-2002 – Characterization of Surges in Low-Voltage (1000 Volts and less) AC Power Circuits.
 - 7. C62.45-2002 – Surge Testing on Equipment Connected to Low Voltage (1000 Volts and less) AC Power Circuits.
 - 8. C62.62-2010 – Test Specification for Surge Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 Volts and less) AC Power Circuits.
 - 9. IEEE 802.3 – Ethernet.
 - B. National Fire Protection Association (NFPA):
 - 1. 70 – National Electrical Code (NEC).
 - C. National Electrical Manufacturers Association (NEMA):
 - 1. 250 – Enclosures for Electrical Equipment (1,000V maximum).
 - 2. KS 1 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
 - 3. ICS 1 – Industrial Control and Systems - General Requirements.
 - 4. ICS 2 – Industrial Control and Systems - Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - 5. ICS 4 – Application Guideline for Terminal Blocks.
 - 6. ICS 5 – Industrial Control and Systems - Control Circuit and Pilot Devices.
 - 7. ICS 6 – Industrial Control and Systems - Enclosures.
 - D. Underwriters Laboratories (UL):
 - 1. 50 – Enclosures for Electrical Equipment.
 - 2. 98 – Enclosed and Dead-Front Switches.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. 489 – Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
 4. 508 – Industrial Control Equipment.
 5. 508A – Industrial Control Panels.
 6. 698A – Industrial Control Panels Relating to Hazardous (Classified) Locations.
 7. 869 – Service Equipment.
 8. 1449 – Surge Protective Devices.
 9. 1778 – Uninterruptible Power Systems.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.
 - C. Product Data: Submit the following for each type of product specified and included as minimum:
 1. Data sheets for all control panel components furnished.
 - D. Qualification Statements:
 1. Fabricator’s qualifications.
 - E. Shop Drawings: Provide the following as minimum:
 1. Fabrication drawings, front elevation, wiring diagrams, and bills of material for control panels.
 2. Electrical connection diagrams showing termination locations for all field wiring. External connection diagrams shall indicate cable number and wire color for field cables terminated at the panel.
 3. Engraving schedule and physical dimensions for nameplates.
 4. Provide heat dissipation calculations for all panels containing programmable logic controllers. Include calculation for ventilation fans if required.
 - F. Special Procedure Submittals:
 1. Test Plan:
 - a. Provide a complete and detailed test plan for the supplied control panels.
 - b. Include procedures for certification, validation, and testing.
 2. Syllabus for Owner training.
 - G. Test and Evaluation Reports:
 1. Factory test reports.
 2. Field test reports.
 - H. Closeout Submittals: Final documentation shall include the following as minimum:
 1. Operation and Maintenance Manuals including the following:
 - a. Operation and maintenance manuals for all components furnished.
 - b. Certified “As-Built”/“As-Installed” drawings.
 - c. Copies of all approved Product Data.
 - d. Copies of all approved Test Reports.
 - e. Spare parts and supply list.
 - f. Warranty Information.
 - g. Contractor Information.
 - I. Maintenance Material Submittals:
 1. Spare Parts:
 - a. Five spare control fuses of each voltage and current rating used.
 - b. One aerosol cans of manufacture’s touch-up paint for each color used. Color shall match the original factory applied color.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

2. Software:
 - a. Soft copy of PLC and touchscreen programs including all programming comments.
 - b. Original CD/DVD-ROM disks and/or flash drives containing all software associated with the supplied managed Ethernet switches.
 - c. Organize and submit all software copies in a 3-ring binder.

- 1.06 QUALITY ASSURANCE:
 - A. Materials and Equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to Bid opening.
 - B. Fabricator Qualifications:
 1. Prior to assembly and installation, submit data of fabricator's experience and qualifications.
 2. Fabrication shall be by a manufacturer or a particular division of a manufacturing firm specializing in control panel construction.
 3. Shall have a minimum of 10 years experience in control panel fabrication.
 4. Panel shall be fabricated in a UL listed panel shop.
 - C. Factory Tests:
 1. The manufacturer shall conduct tests according to industry standard requirements.
 2. Perform factory tests on all control panels and components and subassemblies to assure that all devices and systems are in proper working order before delivery to jobsite.
 3. Test all power, control and communication systems for proper operation.
 4. Simulate actual system operation.
 5. Submit test reports as specified in DIVISION 01.

- 1.07 DELIVERY, STORAGE, AND HANDLING:
 - A. Control panels and associate equipment shall be packaged and shipped to the project site in such a manner as to avoid damage.
 - B. All control panels shall be stored according to the manufacturer's instructions and in a conditioned space to avoid condensation, dust, and other environmental contaminants.

- 1.08 PROJECT SITE CONDITIONS:
 - A. Do not store or install the control panel equipment specified herein until designated installation spaces are suitable for intended service.
 - B. For indoor control panels final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to energizing panel and shall be maintained for the remainder of the construction period.

- 1.09 WARRANTY:
 - A. Surge Protective Devices shall be provided with a minimum 5-year manufacturer's warranty.
 - B. Ethernet switches shall be provided with a minimum 5-year manufacturer's warranty.
 - C. All other equipment shall be provided with a minimum one-year warranty period.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
 - A. Enclosures:
 1. B-Line, Eaton.
 2. Hoffman, Pentair PLC.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Wiegmann, Hubbell, Inc.
4. Milbank Manufacturing Company.
5. Saginaw Control & Engineering.
- B. Circuit Breakers:
 1. Acme Electric.
 2. Allen-Bradley, Rockwell Automation, Inc.
 3. Cutler-Hammer, Eaton.
 4. General Electric Company.
 5. Phoenix Contact.
 6. Square D, Schneider Electric.
- C. Surge Protective Devices:
 1. Advanced Protection Technologies, Inc.
 2. Citel, Inc.
 3. EDCO, Emerson Electric Company
 4. Ferraz Shawmut, Mersen.
 5. MCG Surge Protection, Inc.
 6. MTL Instruments, Eaton.
 7. Phoenix Contact.
 8. Square-D, Schneider Electric.
- D. Terminal Blocks:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. Buchanan, Tyco Electronics Corporation.
 3. Phoenix Contact.
 4. Square-D, Schneider Electric.
 5. Weidmuller.
- E. Push buttons, Selector Switches and Pilot Lights:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. Appleton, Emerson Electric Company.
 3. Cutler-Hammer, Eaton.
 4. IDEC Corporation.
 5. Killark, Hubbell, Inc.
 6. Square-D, Schneider Electric.
- F. Control and Timing Relays:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. Cutler-Hammer, Eaton.
 3. IDEC Corporation.
 4. Phoenix Contact.
 5. Potter & Brumfield, Tyco Electronics Corporation.
 6. Square-D, Schneider Electric.
 7. Turck, Inc.
- G. DC Power Supplies:
 1. Allen-Bradley, Rockwell Automation, Inc.
 2. IDEC Corporation.
 3. Phoenix Contact.
 4. SolaHD, Emerson Electric Company.
- H. Convenience Receptacles:
 1. Cooper Industries, Eaton.
 2. Hubbell, Inc.
 3. Leviton Manufacturing Co., Inc.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- 4. Phoenix Contact.
- I. Interior Illumination:
 - 1. Acuity Brands, Inc.
 - 2. Hoffman, Pentair Inc.
 - 3. Hubbell, Inc.
 - 4. Stego, Inc.
- J. Programmable Logic Controllers (PLC):
 - 1. Schneider Electric.
- K. Operator Interface Touchscreen:
 - 1. Schneider Electric.
- L. Ethernet Switches:
 - 1. Refer to SECTION 40 95 33 – Process Control Networks.
- M. Wiring Duct:
 - 1. Panduit Corporation, H-Type.
- N. Wire Markers:
 - 1. Brady Worldwide, Inc.
 - 2. Panduit.
 - 3. Thomas and Betts Corporation, ABB Group.

2.02 ENCLOSURES:

- A. Totally enclosed panel with gasketed doors, continuous hinge, and three point latching mechanism with lockable handle.
- B. Sized to house all equipment and devices required, provide sufficient space for conduit entry, and provide sufficient heat dissipation for the installed components.
- C. Unless specified or indicated otherwise provide the following enclosure type:
 - 1. NEMA Type 4X stainless-steel enclosure for outdoor and chemical feed locations.
 - 2. NEMA Type 12 painted steel enclosures for indoor electrical rooms.
- D. Unless specified or indicated otherwise provide the following enclosure design:
 - 1. Wall Mount Design:
 - a. Provide for enclosures with a vertical dimension less than 50-inches.
 - b. Formed and welded construction, minimum 14-gauge.
 - c. Interior 12-gage minimum steel mounting panel(s).
 - d. Provide mounting tabs and required hardware for installation of enclosures.
 - 2. Free Standing Design:
 - a. Provide for enclosures with vertical dimensions of 50-inches or greater.
 - b. Formed and welded construction, minimum 12-gauge for single door enclosures and 10-gauge for multi-door enclosures.
 - c. Interior 12-gage steel mounting panel(s)
 - d. Provide door mounted folding shelf for support of instruments and test equipment. Shelf shall be mounted on the interior of the door. For multi-door enclosures provide a shelf for each pair of doors.
 - e. Provide with lifting eyes.
- E. Provide lockable design.
- F. Painted enclosures shall have a light gray polyester powder coat finish on the exterior with a white polyester powder coat finish on the interior.
- G. Accessories:
 - 1. Provide data pocket mounted on the interior of the panel for storage of wiring diagrams.
 - 2. Provide vapor action corrosion inhibitor emitters for each panel. Emitters shall be provided as a minimum based upon twice the calculated volume of the enclosure.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Provide a door stop kit designed to secure the door in the 90 degree open position.
- 2.03 NAMEPLATES:
- A. Fabricate from laminated phenolic sheeting with black core and satin finish melamine overlay.
 - B. Colors shall white with black letters.
 - C. Thickness: 1/16 inch nominal.
 - D. Bevel edges to expose black core on perimeter.
 - E. Engraved legend through overlay to expose core.
 - F. Attach to panels with industrial grade double-faced tape.
- 2.04 CIRCUIT BREAKERS:
- A. 120/240Vac and 24Vdc:
 1. Provide for main disconnecting means for panel and for power distribution within the panel as indicated.
 2. Rated for 120/240Vac and 24Vdc as indicated.
 3. Thermal-magnetic trip units.
 4. Trip rating and curve as recommended by manufacturer of equipment being protected.
 5. DIN rail mounted on the inside of the control panel in a readily accessible location.
 6. Toggle-type handle with a quick-make, quick-break over-center switching mechanism that is mechanically trip-free.
 7. Minimum symmetrical interrupting capacity of 10,000 AIC.
- 2.05 SURGE PROTECTIVE DEVICES:
- A. 120/240V Surge Suppressors:
 1. Provide for 120V/240Vac distribution system within panel to protect electronic components from transient voltage surges.
 2. UL 1449 (3rd Edition) listed.
 3. Shall meet Type 2 SPD criteria with the following minimum protection characteristics:
 - a. I_n : 20kA (per mode)
 - b. SCCR: 100kAIC (minimum)
 - c. MCOV: 150V (L-G), 270 (L-L).
 - d. UL Voltage Protection Rating:
 - (1) L-L: 1000V
 - (2) L-N, L-G, N-G: 600V
 4. Designed for 120/240Vac, single-phase operation.
 5. EMI/RFI filtering.
 6. Peak clamping voltage of 320 volts line to neutral and 350 volts line to ground with Category B waveform.
 7. Minimum continuous series operating current rating of 20Amps.
 8. Minimum surge current capacity of 10 kA per mode (8/20 μ s).
 9. Response time of less than 25 nanoseconds.
 10. Equipped with an LED status indicator for verification that unit is functioning.
 11. NEMA 1 enclosure designed for back panel or DIN rail mounting within a control panel.
 12. Minimum five year warranty.
 13. Provide SPDT contacts for remote indication. Contacts rated 0.5A at 120Vac minimum.
 - B. Panel I/O Surge Suppressors:
 1. Provide DIN rail mounted terminal block type transient voltage surge suppressors for all inputs and outputs that are wired to devices located outside of the building envelope.
 2. Finger safe screw type terminals.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Replaceable surge modules.
 4. Three-stage surge protection.
 5. Provisions for labeling terminal block numbers.
 6. Minimum five year warranty.
 7. Analog and 24Vdc Signal Surge Protection:
 - a. Series surge suppressor.
 - b. Minimum surge current capacity of 10 kA per mode (8/20 μ s).
 - c. Minimum lightning surge current capacity of 500A per path (10/350 μ s).
 - d. Maximum let thru voltage line to ground of 45 Vdc.
 - e. Maximum let thru voltage line to line of 90 Vdc.
 - f. Response time of less than 5 nanoseconds.
 - g. Maximum series resistance of 10 ohms.
 - h. Minimum continuous current rating of 300 mA.
 8. 120Vac Discrete Signal Surge Protection:
 - a. Series surge suppressor.
 - b. Minimum surge current capacity of 4 kA per mode (8/20 μ s).
 - c. Minimum lightning surge current capacity of 2.5 kA per path (10/350 μ s).
 - d. Maximum let thru voltage line to ground 380 Vac.
 - e. Maximum let thru voltage line to line of 600 Vac.
 9. Minimum continuous current rating of 15A.
 10. Response time of less than 25 nanoseconds.
- 2.06 TERMINAL BLOCKS:
- A. 600V, sectional type polyamide blocks.
 - B. Rated a minimum of 20A. Provide higher Amp rated blocks as required.
 - C. Tubular clamp contacts.
 - D. Slide in vinyl marking strip for terminal identification.
 - E. Finger safe.
 - F. DIN rail mounted.
- 2.07 SWITCH ACTION FUSE BLOCKS:
- A. Rated 600V.
 - B. Tubular clamp contacts.
 - C. Finger safe.
 - D. DIN Rail mounted.
- 2.08 PUSH BUTTONS AND SELECTOR SWITCHES:
- A. Heavy duty, 30 mm units with contacts rated 10A continuous at 120Vac.
 - B. NEMA 4X rated when installed in NEMA 12 or 4X enclosures.
 - C. Provide the number of contacts and contact development as indicated.
 - D. Start or On push buttons shall have green operators.
 - E. Stop or Off push buttons shall have red operators.
 - F. Emergency Stop push buttons shall have red mushroom head operators.
- 2.09 PILOT LIGHTS:
- A. Heavy duty, 30 mm units.
 - B. NEMA 4X rated when installed in NEMA 12 or 4X enclosures.
 - C. 120Vac or 24Vdc cluster LED type.
 - D. Green lights shall indicate “Equipment On” or “Running”.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- E. Red lights shall indicate “Equipment Off” or “Stopped”.
 - F. Amber lights shall indicate “Equipment Failure” or “Alarm”.
 - G. Push to test type.
- 2.10 CONTROL RELAYS:
- A. Plug-in type relay with neon coil energization indicator.
 - B. Coil voltage: 120Vac or 24Vdc as required.
 - C. Contacts rated 10 Amps at 120Vac.
 - D. Number of contacts as required.
 - 1. Provide one spare N.O. and one spare N.C. contact (minimum).
 - E. Provide DIN rail mounted relay socket with screw type terminations.
- 2.11 TIME DELAY RELAYS:
- A. Plug-in type digital based electronic timing relay with coil energization indicator.
 - B. Coil voltage: 120Vac or 24Vdc as required.
 - C. Contacts rated 10 Amps at 120Vac.
 - D. Timing range as indicated with a minimum setting accuracy of $\pm 2\%$ and repeat accuracy of $\pm 0.1\%$.
 - E. The selection of timing range settings via DIP switches. The time delay within the range shall be set utilizing an adjustment dial.
 - F. Number of contacts as required.
 - 1. Provide one spare N.O. and one spare N.C. contact (minimum).
 - G. Provide DIN rail mounted relay socket with screw type terminations.
- 2.12 DC POWER SUPPLIES:
- A. Provide industrial rated primary switched 24Vdc power supplies as specified and indicated.
 - B. Enclosed design with finger safe input and output terminal blocks.
 - C. Designed for DIN rail or back panel mounting.
 - D. DC power supply rated as follows:
 - 1. Input voltage: 95 to 130Vac.
 - 2. Output voltage: 24Vdc $\pm 1\%$.
 - 3. Output current: 10A minimum with a minimum 25% spare capacity.
 - 4. Line regulation: $\pm 0.2\%$ maximum.
 - 5. Load regulation: $\pm 1.5\%$ maximum.
 - 6. Ripple: < 50 mV pk-pk.
 - 7. No overshoot for turn on, turn off, or power failure.
 - 8. Operating temperature: -25°C to $+60^{\circ}\text{C}$.
 - 9. Overload and short circuit protection.
 - 10. Indicating lights for status.
 - E. DC UPS System:
 - 1. Provide DC power supplies equipped with a UPS System for the following control panels:
 - a. Control Panels with PLCs installed.
 - 2. Shall charge and monitor the battery.
 - 3. Shall automatically switch without interruption to battery power if the primary 120Vac source is lost and switch back automatically to the 120Vac source when power is restored.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

4. The UPS system shall utilize maintenance free lead-acid batteries rated to provide a minimum of 15 minutes of backup time for the connected load with a minimum size of 7Ah.
5. Provide a support rack for the batteries designed for DIN rail or back panel mounting.
6. Equipped with a resettable over current protection to protect the batteries.
7. The batteries shall be field replaceable.
 - a. The unit shall be equipped with an on/off switch to bypass the battery system and allow for replacement of the batteries while the power supply is in operation.
8. The system shall provide relay outputs rated a minimum of 0.25A at 24Vdc to indicate the following:
 - a. AC Power Failure.
 - b. Low Battery/Common Alarm.

2.13 CONVENIENCE RECEPTACLES:

- A. DIN rail mounted, 15-A duplex three-wire grounding GFCI type outlet with enclosure.
- B. Equipped with terminal blocks for power connection.
- C. Outlet shall be protected with a 5 Amp circuit breaker.
- D. One mounted inside control panel for use in powering laptops and test equipment for service of the panel.

2.14 INTERIOR ILLUMINATION:

- A. Provide LED type panel lights.
- B. Minimum 50,000 hour life.
- C. Provide a minimum 50 footcandles at the base of the panel
- D. Powered from 120Vac. Provide required power supply.
- E. Door interlocked switch.

2.15 PANEL MOUNT ETHERNET SWITCHES:

- A. Provide Ethernet switches as indicated and specified. Refer to SECTION 40 95 33 – Process Control Networks for requirements.

2.16 PROGRAMMABLE LOGIC CONTROLLERS (PLC):

- A. Provide Modicon M340 PLCs with a central processing unit capable of communicating on Modbus TCP network.
 1. General:
 - a. The programmable controller shall receive status intelligence, perform logic functions, issue control commands, and provide alarms and status information for the systems described in these Specifications.
 - b. The PLC shall support the following programming languages:
 - (1) Relay ladder
 - (2) Structured text
 - (3) Function block
 - (4) Sequential function charts
 - c. The programmable controller Equipment shall consist of a solid-state control system which has user programmable memory for storage of instructions to implement specific functions.
 - d. The PLC Equipment shall be purposely designed as an industrial control system which can perform functions equivalent to a relay panel or a wired solid-state logic system.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- e. All PLC Equipment provided shall be capable of operation in ambient temperatures of 0°C to 60°C, and 5 to 95% relative humidity (non-condensing), without fans or other cooling equipment.
- f. All external connection points shall be capable withstanding the ANSI surge withstand capability (SWC) test as defined in ANSI/IEEE C37.90.1.
- g. The PLC's shall be capable of being configured as a redundant controller.
- 2. Chassis:
 - a. Provide PLC chassis as required to accommodate the I/O and communications modules required and indicated.
 - b. Provide slot fillers for all unused chassis spaces.
- 3. Power Supplies:
 - a. Provide power supplies for the processor chassis as required.
 - b. Input voltage shall be 24Vdc and provide a minimum of 31 watts of power.
 - c. Power supply model number BMXCPS3020.
- 4. Processor:
 - a. The processor shall be a Modicon model BMXP342020. (Modbus Serial and Ethernet Modbus TCP).
 - b. The processor shall be of solid-state design on modular printed circuit boards.
 - c. The processor shall be equipped with two communication ports an Ethernet Modbus TCP/IP type RJ-45 and a Modbus Serial communication port for programming and communication of data.
 - d. The processor shall include an integrated USB port, 12Mbit/s.
 - e. The processor shall have user-programmable memory with provisions to prevent unauthorized changes.
 - f. The processor shall be equipped with a minimum of 4 Mbytes of user memory. Additional memory shall be provided if required to perform the functions specified.
 - g. Nonvolatile flash memory card shall be provided for storage of the PLC program.
 - h. The processor shall continuously perform diagnostics analysis with a predetermined failure mode in the event of a fault.
 - i. The ladder diagram logic shall be scanned and solved at a rate not to exceed one (1) milliseconds per kiloword of logic.
 - j. All I/O including analog shall be scanned and updated at a rate not to exceed 0.3 milliseconds for all I/O.
 - k. The ladder logic programming shall include support for subroutines.
 - l. The processor shall include a real time clock and calendar accessible for use by the user program.
 - m. The processor shall have at least two (2) operating modes: Run and Program. These operating modes shall be user changeable via front panel switches and over the PLC communications network.
 - n. The processor shall allow the logic to be modified, in ladder logic format, while the processor is in the Run mode without affecting the operation of those portions of the logic not being modified.
 - o. The processor shall allow disabling and forcing on and off of individual input and output when the processor is in the Run mode.
 - p. The processor shall provide selectable timed interrupt capabilities for the user to incorporate into the ladder logic.
 - q. The processor shall provide user defined fault routine capabilities.
 - r. The processor shall automatically clear all output and update all input on power-up and prior to scanning and solving any logic.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- s. The processor shall provide the user with a status bit for use in the ladder logic for initialization purposes. This status bit shall be set/reset based on the indicating the first ladder logic scan.
- t. The processor shall provide a comprehensive instruction set including:
 - (1) Relay Contact Input:
 - (a) Normally open.
 - (b) Normally closed.
 - (c) Transitional.
 - (2) Relay Coil Output:
 - (a) Standard.
 - (b) Retentive.
 - (3) Timers:
 - (a) On delay.
 - (b) Off delay.
 - (c) Duration.
 - (d) Retentive
 - (e) Time bases of 1.0 sec, 0.1 sec, and 0.01 sec.
 - (4) Counters:
 - (a) Count up.
 - (b) Count down.
 - (5) Arithmetic:
 - (a) Single-precision.
 - (b) Double-precision.
 - (c) Integer.
 - (d) Add.
 - (e) Subtract.
 - (f) Multiply.
 - (g) Divide.
 - (h) Square root.
 - (i) Less than.
 - (j) Greater than.
 - (k) Equal.
 - (6) Logical:
 - (a) And.
 - (b) Or.
 - (c) Exclusive or.
 - (d) Compare.
 - (7) PID.
- 5. PLC Input and Output Modules:
 - a. Digital input modules shall be 16 point, 24Vdc model number BMXDDI1602.
 - b. Digital output modules shall be 16 point 24Vdc model number BMXDDO1602.
 - c. Analog input modules shall be 4 point, multi-range, isolated model number BMXAMI0410.
 - d. Analog output modules shall be 4 point, multi-range, isolated model number BMXAMO0410.

2.17 OPERATOR INTERFACE TOUCHSCREEN (OIT):

- A. Provide for PLC cabinets where indicated and specified.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

- B. Provide a 10” flat panel color TFT display (16-bit color, minimum). Resolution shall be 640x480 minimum.
- C. Luminance shall be a minimum of 300 cd/m2 (Nits) with a field replaceable backlight.
- D. Display unit shall have a minimum of 96MB flash EPROM and 512kB internal RAM.
- E. Environmental operating temperature range shall be 0 to 50°C, at 5 to 95% non-condensing relative humidity.
- F. Shall be panel mounted with a NEMA rating to match the associated enclosure rating.
- G. Provide the following external ports and interfaces as minimum:
 - 1. One SD Card (SDHC), Include compatible 32GB SD card.
 - 2. One USB-2.0 ports.
- H. Communication interfaces shall include the following as minimum:
 - 1. One RJ-45 Ethernet (10/100 Mb Autosensing).
 - 2. One RS232 Serial Port (DB9).
- I. Shall accept input power from 24VDC supply.
- J. Shall be capable of communicating over the Modbus TCP network as indicated.
- K. Provide Magelis HMIGTO5315 or Engineer approved equal.

2.18 PLC I/O:

- A. Refer to the I/O Lists at the end of SECTION 40 96 35 – Process Control Software Programming and Reports for a list of I/O required to be provided for the plant control system.

2.19 ELECTRICAL SYSTEM:

- A. Wiring:
 - 1. UL style 1015, machine tool wire (MTW), 600V, 90°C.
 - 2. No. 14 AWG, 19 strand, for all control wiring.
 - 3. No. 18 AWG, shielded twisted pairs for all instrumentation wiring.
 - a. Color code shall be black/red pair with black (blue) PVC jacket.
 - 4. Wire Colors:
 - a. Black: un-switched, ungrounded AC wiring.
 - b. Red: switched, ungrounded AC wiring.
 - c. White: AC neutral.
 - d. Green: ground.
 - e. Blue: DC(+).
 - f. White w/ Blue Tracer: DC(-) grounded.
- B. Wire Markers:
 - 1. Heat shrinkable, tube-type sleeve markers, constructed of polyolefin material.
 - 2. White sleeves with black thermal printed text.
 - 3. Identify both ends of wire with the same unique wire number.
 - 4. Assign wire numbers where specific designations are not indicated.
 - 5. Markers sized for snug fit for wire size.
- C. Wiring Duct:
 - 1. Provide wide slot wiring duct in panel for routing of panel wiring. Slots shall be a minimum of 0.25-inches.
 - 2. Provide with dual hinge, push-on cover that opens a minimum of 100 degrees to either side.
 - 3. Wiring ducts shall be sized to accommodate all installed wire plus a minimum of 25% spare capacity.
- D. Ground Bus:
 - 1. Provide isolated copper ground bus.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

2.20 ARC FLASH LABEL:

- A. Provide a 6 x 4 inch (minimum), plastic arc flash label for each control panel.
- B. Label shall be orange and white.
- C. Label shall read as follows: WARNING – Arc Flash and Shock Hazard. Appropriate PPE and Tools Required When Working on this Equipment.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify site conditions are suitable for installation of equipment.
- B. For indoor control panels final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to energizing panel and shall be maintained for the remainder of the construction period.

3.02 PANEL FABRICATION:

- A. Install all components in the panel as required and recommended by the manufacturer.
- B. Provide master nameplate and nameplates for all operator interfaces. Interior nameplates shall be provided for individual component identification including, but not limited to, power supplies, PLCs, control relays, terminal blocks, Ethernet switches, circuit breakers, etc.
- C. Provide interior illumination for all panels equipped with a PLC.
- D. Power Distribution:
 - 1. Provide circuit breakers for protection of equipment in the panel and distribution of power to equipment powered from the control panel.
 - 2. Provide 120Vac circuit breakers to distribute power within the control panel. Circuit breakers shall be sized based upon connected load. As a minimum, dedicated circuit breakers shall be provided for the following:
 - a. Incoming power sources.
 - b. Each device such as lights, fans, heaters, receptacles installed within the panel.
 - c. PLC power supplies (120Vac).
 - d. 24Vdc power supplies.
 - e. Each 120Vac digital input or output module.
 - f. Each 120Vac instrument or device powered from the panel.
 - 3. Provide 24Vdc circuit breakers to distribute power within the control panel. Circuit breakers shall be sized based upon connected load. As a minimum dedicated circuit breakers shall be provided for the following:
 - a. Output of 24Vdc power supply.
 - b. PLC power supply (24Vdc).
 - c. Each 24Vdc digital input or output module.
 - d. Each loop powered instrument.
 - e. Each analog input module, if required.
 - f. Each analog output module, if required.
 - g. Each 24Vdc instrument or device powered from the panel.
 - 4. Provide signage on panel to clearly indicate that the panel is powered from multiple sources if applicable.
- E. Surge Protection:
 - 1. Provide surge protection on 120Vac distribution systems within the panel to protect electronic components from transient voltage surges.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

2. Provide surge protection on all power circuits to instruments installed outside of the building envelope in which the control panel is installed. The terminal block type surge suppressor shall be the termination point for the field cabling.
 3. Provide surge protection on all inputs and outputs that are connected to equipment outside of the building envelope in which the control panel is installed. The terminal block type surge suppressor shall be the termination point for the field cabling.
- F. Component Mounting:
1. Operator interfaces and indicating lights shall be installed in the door of the panel at a convenient height for operator interaction.
 2. Components shall be mounted to provide complete accessibility to all terminals, relay sockets, and other devices without dismantling of panel equipment.
 3. Provide sufficient space around and layout components to allow for proper heat dissipation.
 4. Provide sufficient space at the top and bottom of the panel for conduits and cable entry. Conduit entry locations shall be coordinated with the installing Contractor.
- G. PLC I/O:
1. Provide interposing relays for all discrete outputs from the PLC including spare points.
 2. Wire all inputs and outputs from the PLC to terminal blocks.
- H. Wiring Methods:
1. Route main groups of wires in plastic nonflammable wiring duct.
 2. Smaller groups of wire shall be cabled and secured with nylon cable clamps and ties or plastic spiral wraps.
 3. Maintain physical separation of power, control and instrumentation cables within the panel.
 4. Provide dedicated wiring ducts for management of field cables within the panel. Wiring ducts shall be sized to accommodate multi-conductor control cables. Assume a minimum of 25% spare conductors and provide a minimum of 25% spare capacity when sizing wiring ducts.
- I. Terminal Blocks and Connections:
1. Provide terminal blocks for all external connections.
 2. Make all connections on terminal blocks.
 3. Follow manufacturer's recommendations for terminal block installation.
 4. Connect terminal blocks for instrumentation cable shields to isolated ground bus.
 5. Provide required grounding type terminal blocks.
- J. Spare Capacity:
1. Provide a minimum of 20 percent or 1 circuit breakers, whichever is greater, for each power source (Vac and Vdc) present within the panel. All spare circuit breakers shall be mounted, wired, and include provisions to terminate associated neutral or negative conductors.
 2. Provide a minimum of 2 spare slots in each PLC chassis. Provide blank filler modules for all empty slots.
 3. Provide a minimum of 20 percent spare PLC inputs and outputs for each type in each panel. All spare points shall be wired to field terminal blocks.
 4. Provide a minimum of 20 percent spare terminal blocks of each type mounted in the panel.
 5. Provide spare DIN rail space for the installation of terminal blocks for all spare slots in the PLC chassis plus 20%.
- K. Provide labeling on all terminal blocks, wiring and relays to match panel drawings.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3.03 UNITERRUPTIBLE POWER SUPPLY INSTALLATION:

- A. A DC power supply with a UPS system shall be provided and installed for each panel containing a PLC.
- B. Status contacts shall be wired to the PLC for remote monitoring.

3.04 ETHERNET SWITCH INSTALLATION:

- A. Install Ethernet switches in control panels and make connections as indicated.
- B. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
- C. Shall provide adequate ports for connection to the plant control system, PLC, touchscreen and provide a minimum of one spare programming port.

3.05 PLC PROGRAMMING:

- A. Refer to SECTION 40 96 35 – Process Control Software Programming and Reports for PLC programming requirements.
- B. The PLC shall be programmed to perform the required logic for proper operation of the equipment.
- C. The PLC program shall be thoroughly documented with explanations in the program of the operation performed in each program line or rung.
- D. The PLC shall monitor power status to the control panel. Logic shall be implemented that shall clear run contacts when power is lost and perform routine startup of equipment after a power restoration.
- E. Control and status points specified to be communicated with the plant control system shall be tagged as specified and indicated and shall be organized to provide efficient communication with the plant control system.
- F. Shall be programmed utilizing the version of Unity programming software currently in use for the existing PLCs. Coordinate version with Owner for each project site.
- G. Soft copy of the program shall be provided to the Owner.

3.06 TOUCHSCREEN PROGRAMMING:

- A. The touchscreen shall be programmed to provide required operator interfaces with the chemical metering equipment and associated ancillaries of the fluoridation facilities.
- B. Shall be programmed utilizing the latest version of Windows based programming software from the manufacturer.
- C. Screens shall be laid out in a logical order with a main overview screen and links from each screen back to the main overview screen.
 - 1. Operator adjustable set points shall be password protected.
- D. The screen layout and graphics used for the touchscreen interface shall match those developed for the plant control system Wonderware screens.
- E. The color green shall indicate “Equipment On” or “Valve Open” and red shall indicate “Equipment Off” or “Valve Closed”.
- F. Store a copy of the final HMI program on the OIT SD card.
- G. Both a hard and soft copy of the final application shall be provided to the Owner.

3.07 INSTALLATION:

- A. Control Panels:
 - 1. Conform to manufacturer’s written instructions.
 - 2. Surface-mount wall mount enclosures on structural supports or wall approximately 4 feet to center line above the floor when possible.

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE: CONTINUED

3. Install floor mounted enclosures where indicated and bolt to floor using expansion type concrete anchors.
 4. Install all necessary openings in panels.
 5. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
 6. Mount plumb and level.
 - B. Electrical Connections:
 1. Install wire and cable as specified in DIVISION 26.
 2. Conform to manufacturer's wiring diagrams.
 3. Install circuits to field-mounted equipment as indicated and required.
 - C. Place arc flash label on equipment.
- 3.08 FIELD QUALITY CONTROL:
- A. Manufacturer's Field Services:
 1. The panel supplier shall provide the field services of a trained technician for the amount of time required to commission, test and start-up all equipment provided.
 2. All travel and living expenses shall be included for all trips to the site. All equipment required for testing, start-up and performance verification shall be provided by the start-up technician.
 - B. Check all internal and external connections and tighten as required.
 - C. Perform I/O checkout on all points and verify proper operation.
 - D. Verify proper connection of communication cabling and proper communication system configuration.
 - E. Field verify proper operation of all inputs and outputs.
 - F. Record results of I/O checkout and submit test reports as specified in DIVISION 01.
- 3.09 ADJUSTING AND CLEANING:
- A. After field installation and final wiring terminations are completed the control panel wiring and cables shall be adjusted and neatly secured with tie wraps, hook-and-loop straps, or the like.
 - B. Wiring duct covers shall be replaced and secured as required.
 - C. Prior to final acceptance control panel interior and exterior shall be wiped clean and free from dust and debris.
- 3.10 TRAINING:
- A. Provide a minimum of 4 hours of training for each panel provided at the customer's facility for operations, maintenance and service personnel.
 1. The training session shall include classroom discussion on the theory of operation of the equipment, as well as maintenance and service methods for the purchased equipment.
 2. Topics covered shall include safety, hardware layout and functions, power and control wiring, diagnostic indicators, keypad/display interface, faults, diagnostic tools, troubleshooting, and preventive maintenance.
 3. Hands-on training shall be provided on equipment.
 4. Documentation shall be provided which shall include actual manuals for the equipment and drawings and schematics of equipment supplied for this project.
 - B. The Owner at their option shall be allowed to video record all training sessions for future reference.

END OF SECTION 40 95 13

SECTION 40 95 33 – PROCESS CONTROL NETWORKS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This SECTION specifies infrastructure and equipment for process control networks. This SECTION includes the following:
 1. Fiber Optic Cabling and Accessories.
 2. UTP Cabling and Accessories.
 3. Ethernet switches.
 4. Industrial Media Converters.

1.03 RELATED REQUIREMENTS:

- A. SECTION 26 05 26 – Grounding and Bonding for Electrical Systems.
- B. SECTION 26 05 33 – Raceways, Boxes, and Supports for Electrical Systems.
- C. SECTION 26 05 43 – Underground Duct Banks and Manholes.
- D. SECTION 26 05 53 – Identification for Electrical Systems.
- E. SECTION 40 95 13 – Process Control Panels and Hardware.

1.04 REFERENCE STANDARDS:

- A. Applicable Codes and Standards: Design, fabricate, assemble and test material so as to conform with all applicable codes and standards including, but not limited to the following:
 1. Electronic Components Industry Association (ECIA):
 - a. EIA/ECA-310-E – Cabinets, Racks, Panels, and Associated Equipment.
 2. Insulated Cable Engineer's Association (ICEA):
 - a. ICEA S-83-596 – Fiber Optic Premises Distribution Cable.
 3. Institute of Electrical and Electronic Engineers (IEEE):
 - a. IEEE 802.1 – Local and Metropolitan Area Networks.
 - b. IEEE 802.3 – Ethernet.
 - c. IEEE 802.11 – Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications.
 4. National Fire Protection Association (NFPA):
 - a. NFPA 70 – National Electrical Code.
 5. Telecommunications Industry Association (TIA)
 - a. TIA-455-21A – FOTP 21 Mating Durability of Fiber-Optic Interconnecting Devices.
 - b. TIA-492AAAA-B – 62.5 Micrometer Core Diameter/125 Micrometer Cladding Diameter Classes 1a Graded Index Multimode Optical Fibers.
 - c. TIA-526-14-B Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
 - d. TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises.
 - e. TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard.
 - f. TIA-568-C.2 – Balanced Twisted Pair Cabling and Components Standards.
 - g. TIA-568-C.3 – Optical Fiber Cabling Components Standard.
 - h. TIA-607-B – Commercial Building Grounding and Bonding Requirements for Telecommunications.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

6. Underwriter's Laboratories, Inc. (UL):
 - a. UL 44 – Thermoset-Insulated Wires and Cables.
 - b. UL 467 – Grounding and Bonding Equipment.
 - c. UL 514C – Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
 - d. UL 969 – Marking and Labeling Systems.
 - e. UL 1581 – Electrical Wires, Cables, and Flexible Cords.
 - f. UL 1651 – Safety Optical Fiber Cable.
 - g. UL 1666 – Flame Propagation Height of Electrical and Optical Fiber Cables Installed in Vertical Shafts.
 - h. UL 1863 – Communication Circuit Accessories.
 - i. UL 60950-1 – Information Technology Equipment - Safety - Part 1: General Requirements.
- 1.05 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Product Data: Submit for each type of product specified and included the following as minimum:
 1. Data sheets for each cable type and equipment specified.
 2. Cable manufacturer's approval of pulling compounds.
 3. Cable manufacturer's installation requirements such as maximum pulling tensions, sidewall pressures, minimum bending radii, reel dimensions, etc.
 4. Other equipment and materials to be used.
 5. Description of cable identification tags and attachment methods which will be used.
 - C. Qualification Statements:
 1. Installer's qualifications.
 - D. Shop Drawings: Provide the following as minimum:
 1. Drawings indicating equipment layout and cable management plan.
 - E. Special Procedure Submittals:
 1. Test Plan:
 - a. Provide a complete and detailed test plan for the fiber optic and UTP cabling system including a complete list of test equipment.
 - b. Include procedures for certification, validation, and testing.
 - F. Test and Evaluation Reports:
 1. Factory test reports.
 2. Field test reports.
 - G. Closeout Submittals: Final documentation shall include the following as minimum:
 1. Operation and Maintenance Manuals including the following:
 - a. Preventive maintenance plan and schedule.
 - b. Copies of all approved Shop Drawings.
 - c. Copies of all approved Product Data.
 - d. Copies of all approved Test Reports.
 - e. Spare parts and supply list.
 - f. Warranty Information.
 - g. Contractor Information.
 - H. Maintenance Material Submittals:
 1. Spare Parts:
 - a. Fiber and UTP patch cables: Provide spares as specified herein.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

2. Software:
 - a. Original CD/DVD-ROM disks and/or flash drives containing all software associated with the supplied network hardware.
 - b. Organize and submit in a 3-ring binder.
- 1.06 QUALITY ASSURANCE:
- A. Materials and Equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to Bid opening. Each major component of the equipment shall have the manufacturer's name and type identified on the equipment. All products supplied shall be specifically designed and manufactured for use with plant communications systems. All items of the same class of equipment shall be the products of a single manufacturer unless indicated otherwise.
 - B. Factory Tests:
 1. Quality Control Test Protocol: The manufacturer shall conduct tests according to industry standard requirements. These tests shall be performed routinely on sample sizes sufficient to verify quality and continuity or as specified.
 2. The end-to-end attenuation of each reel of fiber optic cable supplied shall be tested. All of the fibers per reel shall be tested. The results shall be recorded and provided with the cable when shipped. A copy of these test reports shall be submitted to Engineer.
 - C. Fiber Optic Cable Site Tests:
 1. Upon delivery of the fiber optic cable to the specified location, the Contractor shall perform acceptance testing.
 2. Perform optical fiber end to end attenuation tests using an optical light meter and manufacturer's recommended test procedures.
 3. Perform tests in accordance with TIA-526-14-B, Method B for horizontal, multimode optical fiber.
 4. Owner and Engineer's Project Representative shall be present to witness the specified testing.
 5. Copies of the tests showing the attenuation results for each fiber shall be submitted to the Owner and Engineer no later than 5 days after acceptance of the cable.
 6. Any visible damage to the cable construction should be brought to the Engineer's attention immediately.
 7. Refer to PART 3 – EXECUTION for additional site testing requirements.
 - D. Installer Qualifications:
 1. Prior to installation, submit data of installer's experience and qualifications.
 2. Installers shall be a Building Industry Consulting Service International (BICSI) Registered Cabling Installation Technician or have experience which shall include 3 years on projects of similar complexity.
 3. Include names and locations of two projects successfully completed using managed Ethernet switches, optical fiber and copper communications cabling systems.
 4. Include written certification from users that systems have performed satisfactorily for not less than 18 months.
 5. Include specific experience in installing and testing structured communications distribution systems using managed Ethernet switches, optical fiber, and Category 6 cabling systems.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Network hardware and associate equipment shall be packaged and shipped to the project site to avoid damage.
- B. All network appliances shall be stored according to the manufacturer's instructions and in a conditioned space to avoid condensation, dust, and other environmental contaminants.

1.08 PROJECT SITE CONDITIONS:

- A. Do not store or install the network equipment specified herein until designated installation spaces are enclosed, weather tight, and free of contaminants.
- B. Final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to installation and shall be maintained for the remainder of the construction period.

1.09 WARRANTY:

- A. Ethernet switches and other network appliances shall be provided with a minimum 5-year manufacturer's warranty.
- B. All other equipment shall be provided with a minimum one-year warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Fiber-Optic Cables:
 - 1. AFL.
 - 2. Avaya Inc.
 - 3. Belden Inc.
 - 4. Berk-Tek, Nexans.
 - 5. Draka Cableteq USA Corporation, Prysmian Group.
 - 6. Corning Optical Communications.
 - 7. CommScope Inc.
 - 8. General Cable Technologies Corporation.
 - 9. Optical Cable Corporation.
 - 10. Superior Essex Inc.
- B. Fiber-Optic Cable Connectors, Duplex Jumpers, Patch Panels and Accessories:
 - 1. AFL.
 - 2. Avaya Inc.
 - 3. Corning Optical Communications.
 - 4. Ortronics, Legrand.
 - 5. Panduit.
- C. UTP Cables, Patch Panels, Connectors and Accessories:
 - 1. Belden.
 - 2. Berk-Tek, Nexans.
 - 3. Leviton.
 - 4. Mohawk, Belden.
 - 5. Ortronics, Legrand.
 - 6. Panduit.
 - 7. Siemon.
- D. Ethernet Switches:
 - 1. Hirschmann, Belden Inc.
 - 2. Moxa Inc.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

3. GarrettCom, Inc.
4. N-Tron Corporation.
- E. Industrial Media Converters:
 1. Black Box Corporation.
 2. Hirschmann, Belden Inc.
 3. Moxa Inc.
 4. GarrettCom, Inc.
 5. N-Tron Corporation.
- F. Cable Accessories:
 1. Tape:
 - a. Minnesota Mining and Manufacturing (3M).
 2. Cable Ties:
 - a. AMP, TE Connectivity Ltd.
 - b. IDEAL Industries, Inc.
 - c. Minnesota Mining and Manufacturing (3M).
 - d. Panduit.
 - e. Thomas and Betts Corporation, ABB Group.
 3. Cable Supports:
 - a. O-Z Gedney, Emerson Electric Co.

2.02 FIBER-OPTIC CABLE:

- A. General:
 1. Surface printing on cable shall show manufacturer's name, jacket types, number of conductors, numbered footage markers, and words "Fiber-Optic Cable" or "Optic Cable". The markings shall be in contrasting color to cable jacket.
 2. Cable operating temperature range (long term and storage) shall be from -40°C to +85°C (-40°F to +185°F).
 3. Standard factory tests shall be performed on all cable.
 4. Cable shall meet the following requirements:
 - a. Shall contain multimode fibers in numbers indicated.
 - b. Shall consist of 900 µm tight buffered optical fibers, stranded together with aramid yarn strength members and contained in a PVC outer jacket.
 - c. All cable elements shall be stranded together to maintain flexibility. Stiff central elements such as wire or dielectrics epoxy glass rods shall not be permitted. Aramid yarn strength member elements shall be precision tensioned and uniformly distributed around the fibers.
 - d. Jacket shall be PVC and rated for indoor and outdoor installation. Jacket shall be fungus-resistant, UV inhibited, flame retardant, and contain a rip cord for easy removal. Tape separators are not allowed.
 5. Cable shall meet the flame test requirements of UL 1666 and UL 1651.
 6. Cable shall be certified to be in conformance with all applicable requirements of UL OFNR.
 7. Cable shall meet the ICEA S-83-596 requirements and TIA-492AAAA-B if applicable.
 8. Cable shall meet UL 1581 requirements.
- B. Optical Fibers:
 1. Provide multimode optical fibers.
 2. Each fiber shall have a tight buffer 900 µm, color coded, mechanically strippable, acrylate protective coating.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

3. The entire fiber length per reel shall be unspliced and subjected to a tensile proof stress test equivalent to 100 kpsi for 1.0 second dwell time.
4. Optical Fiber Parameters: The following specifications represent minimum values.
 - a. Shall be multimode graded index with 62.5/125/900 μm fiber/cladding/buffer diameters. Must be FDDI quality or better.
5. Fiber attenuation and bandwidth:

| | | |
|---------------------|-----|------------|
| Optical Wavelength | 850 | 1300 nm |
| Maximum Attenuation | 3.5 | 1.0 dB/km |
| Minimum Bandwidth | 160 | 500 MHz-km |

2.03 FIBER-OPTIC DUPLEX JUMPER/PATCH CORD:

- A. Two-fiber cable with zipcord cable design, riser - rated (UL listed type OFNR).
- B. Fiber shall be 62.5/125 μm , multimode, graded index.
- C. Factory installed ST type connectors on each end of each fiber for patch through cables and connection to panel mounted Ethernet switches as required.
- D. Factory installed ST type connectors on each end for connection to managed Ethernet switches or media converters as required.
- E. Minimum length of 3 feet. Provide longer jumpers as required.
- F. Provide patch cords as indicated plus 25% spare of each type.

2.04 FIBER-OPTIC PATCH PANELS:

- A. Shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross connection.
- B. Shall be capable of terminating number of fibers indicated plus 25% spare capacity.
- C. Shall be equipped with strain-relief and routing guides for incoming cables to ensure minimum bend radius is not exceeded.
- D. Patch panels shall be provided with adapter plates loaded with ST connectors that utilize zirconia ceramic alignment sleeves. Connectors shall be provided with dust covers.
- E. Epoxyless crimp style ST connectors compatible with 62.5/125 multimode fiber and shall have maximum attenuation of .3 dB at 1300 nm with less than a 0.2 dB change after 500 mating cycles.
- F. Shall be provided with labeling space, panel directory and warning labels.
- G. Panel Mounted:
 1. Single compartment enclosure with fiber optic adaptors mounted in the side of unit.
 2. Shall be mounted in NEMA 12 enclosure or within control panels as indicted.
 3. Coordinate size of patch panel with control panel manufacturer.

2.05 UNSHIELDED TWISTED PAIR (UTP) CABLE:

- A. Provide four each individually twisted pair, 24 AWG conductors, 100 ohm, NFPA 70 CMP rated, with PVC jacket.
- B. Individual pairs shall be constructed to contain minimum two twists per foot per each pair.
- C. Overall diameter of four pair cable shall not exceed 0.25 inches.
- D. Ultimate breaking strength shall be minimum 90 pounds.
- E. Shall withstand a bend radius of one inch minimum at a temperature of minus 20°C maximum without jacket or insulation cracking.
- F. Conductors shall be color coded and polarized in accordance with TIA/EIA 568 C.2.
 1. Category 6 UTP shall meet or exceed the standards set forth in TIA/EIA-568-C.2.
 - a. Insertion Loss (Maximum): 32.8 dB/100 m @ 250 MHz.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

- b. NEXT (Minimum): 38.3 dB/100 m @ 250 MHz.
 - c. PSNEXT (Minimum): 36.3 dB/100 m @ 250 MHz.
 - d. ELFEXT (Minimum): 19.8 dB/100 m @ 250 MHz.
 - e. PSELFEXT (Minimum): 16.8 dB/100 m @ 250 MHz.
 - f. Propagation Delay (Maximum): 536 ns/100 m @ 250 MHz.
 - g. Velocity of Propagation (Minimum): 62.1% @ 250 MHz.
 - h. Propagation Delay Skew (Maximum): 45 ns/100 m @ 250 MHz.
 - i. Return Loss (Minimum): 17.3 dB/100 m @ 250 MHz.
- G. Cable shall meet UL 1581 requirements.
- 2.06 UTP JUMPER/PATCH CORD:
- A. Patch cords shall consist of factory assembled, 4 pair, 100 ohm UTP, Category 6 cables and equivalent eight-position, RJ 45 wiring connectors at each end.
 - B. Cables shall be wired with straight through pinning and shall be label verified.
 - C. Cable jacket shall be factory marked indicating organization and performance level.
 - D. Cable assemblies shall be designed with strain relief at each connector.
 - E. Cables shall be terminated according to type T568B configuration as defined by TIA-568-C.1.
 - F. Minimum length of 2 feet. Provide longer jumpers as required.
 - G. Provide patch cords as indicated plus 25% spare.
 - H. Cable shall meet UL 1581 requirements.
- 2.07 PANEL MOUNT UNMANAGED ETHERNET SWITCHES:
- A. Panel mounted unmanaged Ethernet switches shall be 10/100 Mbps autosensing and operate using the Store and Forward Method.
 - B. Compact Industrial DIN rail mounted design.
 - C. Convection cooled with no fans and designed for an industrial environment.
 - D. Operating temperature 0°C to 60°C minimum.
 - E. Shall provide half and full duplex operation.
 - F. Provide with a minimum of 6 - 10/100 Base-TX RJ-45 ports.
 - G. Provide with a minimum of 2 - 100 Base-FX ports for connection to the fiber backbone. Provide with multimode ST type connectors.
 - H. Input power 24Vdc with terminal blocks for connection.
 - I. LED indicators for system status, each power supply status, fault.
- A. Provide an alarm output contact rated a minimum of 0.5 Amp at 30Vac (60Vdc). Contact shall close when a fault condition is detected.
 - B. LED indicators for each port indicating link, activity, full/half duplex mode and speed.
 - C. Comply with IEEE 802.3 and 802.3U.
 - D. Shall be UL listed and FCC approved. Unit shall be rated for continuous operation under the environmental temperature, humidity, and vibrating conditions encountered at the installed location.
- 2.08 INDUSTRIAL MEDIA CONVERTER:
- A. DIN rail mounted 10/100Base-TX to 100Base-FX media converter.
 - B. Shall be autosensing.
 - C. Support full and half duplex operation and operate using the Store and Forward Method.
 - D. Equipped with one RJ-45 10/100Base-TX port and one ST-type 100Base-FX port.
 - E. LED indicators for power, link status and activity.
 - F. Shall comply with IEEE 802.3 and 802.3U.
 - G. Environmental Specifications:

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1. Operating Temperature: -20° to 60°C.
 2. Ambient Relative Humidity: 5% -95% (non-condensing)
 - H. Powered from 120Vac or 24Vdc power supply. Provide DIN rail mounted power supply sized for the unit if required.
- 2.09 ACCESSORIES:
- A. Cable Supports:
 1. Cable supports for cables in vertical conduit risers or vertical tray, with considerable weight of cables shall be O. Z. Gedney Type "R" wedging plug type or approved equal.
 - B. Cable Ties:
 1. Shall be hook-and-loop (Velcro type) to meet EIA/TIA standards.
 - C. Cable Identification Tags:
 1. Designed to provide a permanent wire and cable identification system.
 2. Show complete cable number including colors.
 3. Cable numbers shall be machine printed, legible, and permanent.
 4. Character size for cable numbers shall be a minimum of 1/8 inch.
 5. Material shall be nonmetallic and impervious to moisture.
 6. Be securely attached to cables and accessible for inspection.

PART 3 - EXECUTION

- 3.01 EXAMINATION:
- A. Verify site conditions are suitable for installation of equipment. The area for installation shall be fully enclosed, weather tight, and free of contaminants.
 - B. Final or temporary HVAC systems shall be in place and operational to maintain the ambient temperatures and humidity conditions at occupancy levels prior to installation and shall be maintained for the remainder of the construction period.
 - C. Verify that all labels and nameplates meet UL 969 standards.
 - D. Any applicable equipment shall meet UL 60950-1.
- 3.02 INSTALLATION:
- A. General:
 1. Cabling, connector assemblies, and associated hardware shall be installed in accordance with TIA 568 C.1, TIA 568 C.2, TIA-568-C.3, TIA 569 C, NFPA 70, and UL standards as applicable.
 - B. Cable:
 1. General Requirements:
 - a. Metal raceway bases, covers, and dividers shall be bonded and grounded in accordance with TIA-607-B and UL 467.
 - b. Install cable in raceway as indicated.
 - c. Do not subject cable to pulling tensions or sidewall pressures in excess of manufacturer's recommendations.
 - d. Contractor shall use a load rated swivel, rated to assure compliance with cable pulling tension as published by the cable manufacturer.
 - e. Attach pulling grips around the cable diameter. Sufficient slack should be provided to cut off several meters of cable after it is in place.
 - f. Do not subject cable to bending radius less than those recommended by the cable manufacturer.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

- g. Support cables at connections or termination points such that any strain on cable will not be transmitted to the connection or termination.
 - h. Install cable supports in vertical runs of conduit, at boxes and at terminations in equipment, and as required to meet intermediate support requirements of National Electrical Code (NEC).
 - i. All pulling compounds shall be approved by cable manufacturer as being compatible with cable materials.
 - j. Follow the cable numbering scheme indicated and attach a cable identification tag to each cable at all termination or end points.
2. Fiber Optic Cable:
- a. Contractor shall exercise due caution during installation of the fiber-optic cable to prevent damage to glass fibers. Follow manufacturer's recommendations for maximum cable lengths.
 - b. Fiber optic cable shall not be spliced.
 - c. Install cables in conduit and underground duct bank as indicated and specified.
 - d. Install pull boxes as required.
 - e. All pull boxes and termination cabinets shall be clearly identified as containing fiber-optic cable.
 - f. Coil a minimum of 20 feet of excess fiber optic cable at each pull box.
 - g. There shall be a minimum of 10 feet of excess fiber-optic cable remaining at all terminations for the purpose of making connections, splices or tests.
 - h. Cable Bends:
 - (1) Make gradual bends of cable, where necessary.
 - (2) Do not allow cable to be sharply bent or kinked at any time.
 - (3) Maximum bending radius of 20x the cable diameter.
 - i. Cable Pulling:
 - (1) Do not exceed manufacturer's recommended pulling tension.
 - (2) Tension shall be monitored at all times with a dynamometer or with a pulling wheel.
 - j. Cable identification tags shall be installed at each pull box.
 - k. Label cable at each termination points with unique number for each cable segment.
 - l. Cable Ties: Dress cables neatly with cable ties using low to moderate pressure.
 - m. Testing Cables: Testing shall be performed in accordance with TIA-568-C.0.
 - (1) Clean all connections and adapters at each optical test point prior to taking measurements, as per TIA-526-14-B.
 - (2) The recommended test method shall be TIA-526-14B method B.
 - n. Cable Slack:
 - (1) Leave extra slack on cables, neatly coiled-up in patch panel box.
 - (2) Leave a minimum of 10 feet of cable slack at each fiber patch panel.
 - o. Do not install cables taut.
3. UTP Cable:
- a. Communications cabling and pathways with copper media shall be installed in accordance with the following criteria to avoid potential electromagnetic interference between power and communications equipment.
 - (1) The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the communications cabling.
 - (2) Pathways shall be installed in accordance with the following minimum clearance distances of 4 feet from motors, generators, frequency converters, transformers, or uninterruptible power system, 12 inches from power conduits

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

and cable systems, 5 inches from fluorescent or high frequency lighting system fixtures.

- b. Screw terminals shall not be used.
 - c. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations.
 - d. Do not untwist Category 6 UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
 - e. Provide service loop on each end of the cable, 10 feet at the equipment rack and 12 inches at the jack.
 - f. Do not exceed 25 pounds pull tension for four pair copper cables.
 - g. Do not chafe or damage outer jacket materials.
 - h. Do not over cinch cables, or crush cables with staples.
 - i. UTP cable bend radii shall not be less than four times the cable diameter.
4. Cable Connections and Terminations:
- a. Contractor shall provide a qualified technician to make all connections and terminations cable as specified.
 - b. All cable connections and terminations shall be made according to manufacturer's instructions.
 - c. Make only in terminal boxes, equipment or other accepted enclosures and not in conduit or cable tray.
 - d. Install all connectors with manufacturer's approved tooling.
 - e. Cable identification markers shall be installed at each connection.
- C. Fiber Optic Patch Panels:
1. Install panel mounted enclosures in NEMA rated enclosure or control panels as specified and indicated. For panels installed in equipment manufacturer's control panels coordinate with supplier for required panel space and location.
 2. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
 3. Install adaptor plates and connectors in accordance with manufacturer's recommendations.
 4. Utilize panel spools for slack management of individual fibers.
 5. Mount plumb and level.
 6. Complete panel directory and labeling.
- D. UTP Patch Panels:
1. Install in equipment racks.
 2. Punch down cables as specified.
 3. Install cable strain relief and routing guides.
 4. Wire to T568B configuration.
 5. Complete port labeling.
- E. Ethernet Switches:
1. Install Ethernet switches in control panels and make connections as indicated.
 2. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
 3. Wire switch fault contacts to PLC as required to alert operators of switch problems or failures.
- F. Industrial Media Converters:
1. Mount the industrial media converters where indicated.
 2. Install power supplies as required and make connections as indicated.
 3. Configure media converters per manufacturer instructions.

SECTION 40 95 33 – PROCESS CONTROL NETWORKS: continued

3.03 FIELD QUALITY CONTROL:

A. System Tests:

1. Perform communications cabling inspection, verification, and performance tests in accordance with TIA-568-C.0, TIA-568-C.1, TIA-568-B.2 and TIA-568-C.3.
2. Inspect all cabling terminations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.2.
3. Perform optical fiber end to end attenuation tests using an optical light meter and manufacturer's recommended test procedures.
 - a. Perform tests in accordance with TIA-526-14-B, Method B for horizontal, multimode optical fiber.
 - b. Perform verification acceptance test on each fiber after installation of the cable.
 - c. Any excessive losses due to installation, connectors, etc., shall be identified and corrected by the Contractor and tested with no additional charge.
4. Category 6 Links: Perform UTP link tests in accordance with TIA-568-C.2.
 - a. Tests shall include wire map, length, attenuation, NEXT, and propagation delay.
5. After acceptance of communication cable system, all additional components (including Ethernet switches and jumpers) shall be installed and operation of the complete system tested.
6. Copies of the test shall be submitted to the Engineer for acceptance of the communication system.

3.04 ADJUSTING AND CLEANING:

- A. All network cables shall be adjusted and neatly secured with tie wraps, hook-and-loop straps, or the like.
- B. Prior to final acceptance all network equipment shall be wiped clean and free from dust.

3.05 TRAINING:

- A. The Ethernet switch supplier shall provide a minimum of 2 hours of training at the customer's facility for operations, maintenance and service personnel.
 1. The training session shall include classroom discussion on the theory of operation of the equipment, as well as maintenance and service methods for the purchased equipment.
 2. Topics covered shall include hardware layout and functions, programming and configuration, diagnostic indicators, faults, diagnostic tools, troubleshooting, and preventive maintenance.
 3. Hands-on training shall be provided on equipment.
 4. Documentation shall be provided which shall include actual hard copies of manuals for the equipment supplied for this project.
- B. The Owner at their option shall be allowed to video record all training sessions for future reference.

END OF SECTION 40 95 33

SECTION 40 96 35 – PROCESS CONTROL SOFTWARE PROGRAMMING AND REPORTS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this SECTION.
- 1.02 SUMMARY:
- A. This Section includes control descriptions and requirements for the PLC and HMI system programming.
 - B. The System Integrator shall be responsible for all PLC and HMI system programming.
 - C. Related Work Specified Elsewhere:
 - 1. All applicable Divisions.
- 1.03 RELATED REQUIREMENTS:
- A. SECTION 40 91 00 – Instrumentation for Process Systems.
 - B. SECTION 40 95 13 – Process Control Panels and Hardware.
- 1.04 SUBMITTALS:
- A. Submit as specified in DIVISION 01.
 - B. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.
 - C. Product Data: Submit for each type of product specified and included the following as minimum:
 - 1. A complete listing of all proposed HMI screens and the corresponding points and parameters that will be displayed on each screen.
 - 2. Submit a minimum of two (colored copies) sample screens developed for similar projects.
 - D. Special Procedure Submittals:
 - 1. Test Plan:
 - a. Provide a complete and detailed testing plan for the control system.
 - 2. Syllabus for Owner training.
 - E. Closeout Submittals: Final documentation shall include the following as minimum:
 - 1. Operation and Maintenance Manuals including the following:
 - a. Provide O&M manuals in electronic and hardcopy format including as a minimum the above information and the following:
 - 2. Soft copies of complete PLC program including all program comments.
 - 3. Hard and Soft copies of all final HMI screens and applications.
 - F. Maintenance Material Submittals:
 - 1. Software:
 - a. Assemble and submit all software and program copies.
 - 2. Organize and submit in a 3-ring binder.
- 1.05 QUALITY ASSURANCE:
- A. Programmer Qualifications:
 - 1. Programming shall be by a System Integrator specializing in system integration for the water/wastewater industry.
 - 2. The Programmer shall be trained on the software specified for this project including Wonderware applications, Unity Pro, and other applicable software packages.

SECTION 40 96 35 – PROCESS CONTROL SOFTWARE PROGRAMMING AND REPORTS: continued

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Products as specified in DIVISION 40.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The intent of the control system specified and indicated is to provide complete control and monitoring capabilities for the new Fluoride Building at the Lee Creek and Lake Fort Smith Water Treatment Plants..
- B. The PLCs, HMI Touchscreens, Wonderware Intouch and Historian applications shall be configured to communicate the required I/O points to the existing operator interface system and associate operator workstations.
- C. The existing control systems utilize a combination of Wonderware Intouch standalone, Intouch for System platform, Intouch for Terminal Services, and Wonderware Historian. Reports are developed using XLReporter.
 - 1. New HMI Screens shall be developed for control interface and monitoring of the systems described. Provide the necessary software licenses and license upgrades necessary for a complete and functional system.
- D. All set points and time delays described in the sequence of operation are initial values and shall be adjustable via an HMI screen by the System Administrator at the operator workstation or local touchscreen.
- E. Screen Development Details:
 - 1. HMI Screens shall be developed for control interface and monitoring of systems, facilities, and related equipment.
 - 2. Screens shall be developed for the local control panel HMI touchscreens and the plant control system operator workstations. The local HMI screens and remote operator workstation screens shall have the same appearance of functionality.
 - 3. All screens shall be developed using high resolution graphics and icons.
 - 4. All HMI screens shall be developed with input from the Owner and Engineer and all screens shall be approved by the Owner prior to startup of the system.
 - 5. The System Integrator shall schedule necessary meetings with the Owner and Engineer to properly coordinate screen development, layout, and other required work to ensure the developed screens and systems best meet the needs and desires of the Owner for operating the facility.
 - 6. All analog values shall be trended and recorded in the historical database.
 - 7. All unused analog points shall be turned off in the HMI and PLC programming.
 - 8. Low, low-low, high and high-high and loss of signal alarm points shall be programmed and available to set for all analog points. The operators shall be able to set values for or disable the alarm points from the HMI screens. If alarm range settings are not provided the alarm settings shall be adjustable over the entire range of the associated the analog value.
 - 9. A minimum of one decimal point of accuracy shall be provided for all analog points displayed on the HMI. Additional decimal places shall be provided where applicable.
 - 10. All automatic control such as start/stop, speed control, flow control, and similar shall be programmed into the nearest local PLC processor. All manual controls such as start/stop, open/close, speed control, etc. shall be incorporated into the PLC programming and

SECTION 40 96 35 – PROCESS CONTROL SOFTWARE PROGRAMMING AND REPORTS: continued

- screens as described this section. All control shall take place in the PLC with the applicable computer servers and workstations maintained for operator interface only.
11. The screen symbology shall show equipment running (green) or not running (red) to match existing symbology.
 12. Provide run time totalization for all equipment in the nearest local PLC processor and display the current value on the relevant screen(s).
 13. Screens shall be developed, or modified, to allow the operator to inhibit alarm points. Protocol shall be established which animates alarms prior to being acknowledged and maintains alarm display until the alarm condition is removed or the alarm is inhibited. Alarms, alarm acknowledgement, and inhibits shall be recorded to an event log.
 14. HMI screen access levels shall match that of the existing system.
 15. As a minimum the following screens shall be developed:
 - a. System Overview Screen:
 - (1) Provide the required modifications to the existing overview screen to include the new fluoride building and associated facilities.
 - (2) Displays for this screen shall at a minimum include the alarm status the facility and flow rate for the facility.
 - (3) Allow the operator to point and click to open a detailed screen for the associated facility.
 - b. Detailed System Screens:
 - (1) A detailed screen shall be developed for each process system.
 - (2) The detailed screens shall display all monitored parameters and allow for the adjustment of the control and alarm associated with the system and/or associated equipment.
 - (3) If a particular system requires additional screens to clearly identify and display all control and status points for the system equipment the Detailed Screen and Overview Screen shall include links to the additional subsystem screens.
 - (4) Links shall be established between related screens and between each screen and the system overview screen.
 - (5) A detailed screen shall be developed for each system including, but not limited to, the following:
 - (a) Chemical Feed System.
 - c. Communications Status Screen:
 - (1) Shall graphically depict the network showing all PLC's, switches, etc., in the system.
 - (2) Shall indicate communication system status for all PLC's and other networked equipment.
 - (3) Provide the necessary updates to the existing communications screen as required for these functions.
 - d. Alarm and Event Management Screens:
 - (1) Provide the necessary updates to the Alarm and Event Management Screen to include all new alarm tags.
 - (2) Shall display alarms and events.
 - (3) Shall list the discrete alarm points and allow the operator to inhibit the alarm and select whether the alarm point causes the audible alarm to sound.
 - (4) Shall allow the operator to set the parameters associated with the audible alarms.

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(5) Shall allow the operator to place the associated equipment alarms into “Out Of Service” mode to prevent out of service equipment from triggering alarms.

e. Event Notification:

(1) Provide the necessary scripts and screen updates to provide audible and visual event notification.

3.02 REPORTS:

A. Reports shall be developed and/or modified with input from the Owner for specific formatting and data presented.

3.03 PROGRAMMABLE LOGIC CONTROLLER (PLC) PROGRAMMING:

A. The new PLCs shall be programmed utilizing Unity programming software as applicable for the specific PLCs. Version shall match what is utilized at each project site. Coordinate with the Owner as required.

B. Any program modifications required for the existing PLCs at the Lake Fort Smith WTP Backwash Pump Station and the Lee Creek WTP Finished Water Pump Station shall be coordinated with the Owner prior to performing the work.

C. The PLC program shall be thoroughly documented with explanations in the PLC program of the operation performed in each program line or rung.

D. The PLC shall be programmed to perform the required logic for proper operation of the associated equipment.

E. The PLC shall monitor communications status on the network and alarm if communication failures occur.

F. Each alarm point shall have a programmed 2 second time delay to prevent “nuisance” or “false” alarms.

G. Momentary start contacts shall be programmed to close for 2 seconds and then open. Momentary stop contacts shall be programmed to open and stay open until shutdown of the motor is detected.

H. All required field programming and tuning of the control loops shall be included.

3.04 FLUOSILICIC BULK STORAGE TANK LEVEL:

A. System Components and Functions:

1. Fluosilicic Acid Bulk Storage Tank: FLU-TNK-001.

2. Level Transmitter: FLU-LIT-001.

a. Measures level in the Fluosilicic Acid Storage Tank FLU-TNK-001.

3. Level Indicator: FLU-LI-001.

a. Display of Fluosilicic Acid Storage Tank FLU-TNK-001 level at filling station.

B. Description of Operation:

1. Tank Level:

a. The level of the tank shall be measured by level transmitters FLU-TNK-001.

b. The level of the tank shall be displayed at the tank filling station on level indicator FLU-LI-001.

c. The level of the storage tank shall be displayed on the operator workstation and high, low and low-low level and loss of signal alarms shall be set for the tank.

d. The tank level shall be trended.

C. Set Points and Ranges:

1. Level Transmitter FLU-LIT-001:

a. Level transmitter with integral display.

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- b. Refer to instrument data sheet for calibration range.
 - 2. Level Indicator FLU-LI-001:
 - a. Calibrated range of 0-100%.
 - 3. Operator Workstation:
 - a. Lake Fort Smith WTP:
 - (1) Display range of 0-10.0 feet and 0-3,000 gallons.
 - (2) Low-low level alarms adjustable between 0-1,000 gallons initially set at 300 gallons.
 - (3) Low level warning adjustable between 0-1,000 gallons initially set at 600 gallons.
 - (4) High level warning adjustable between 0-3,000 gallons initially set at 2,500 gallons.
 - (5) High-high level alarms adjustable between 0-3,000 gallons initially set at 2,800 gallons.
 - b. Lake Fort Smith WTP:
 - (1) Display range of 0-10.0 feet and 0-2,000 gallons.
 - (2) Low-low level alarms adjustable between 0-1,000 gallons initially set at 150 gallons.
 - (3) Low level warning adjustable between 0-1,000 gallons initially set at 300 gallons.
 - (4) High level warning adjustable between 0-2,000 gallons initially set at 1,500 gallons.
 - (5) High-high level alarms adjustable between 0-2,000 gallons initially set at 1,800 gallons.
 - D. System Upsets and Procedures for Recovery:
 - 1. If the storage tank level signal is lost, the control system shall alarm the operator via the operator workstation.
- 3.05 FLUOSILICIC DAY TANK:
- A. System Components and Functions:
 - 1. Fluosilicic Acid Day Tank: FLU-TNK-002.
 - 2. Weight Transmitter FLU-WIT-002.
 - a. Measures the chemical weight in the day tank FLU-TNK-002.
 - 3. Transfer Pump FLU-TP-001.
 - a. Transfers Fluosilicic acid from the bulk storage tank to day tank FLU-TNK-001.
 - 4. Local Control Station FLU-CST-001
 - a. Local control station for local manual control of the transfer pump.
 - B. Description of Operation:
 - 1. Tank Weight:
 - a. The weight of the tank shall be measured by weight transmitter FLU-WIT-002.
 - b. The weight of the tank shall be displayed on the operator workstation. High and low level and loss of signal alarms shall be set for the tank.
 - c. The tank weight shall be trended.
 - 2. Transfer Pump:
 - a. The transfer pump shall be capable of local manual control only.
 - b. Local Control:
 - (1) Starting and stopping of the pump shall be controlled at the associated control station.

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- c. The run status and failure alarm shall be displayed on the operator workstation.
- C. Set Points and Ranges:
 - 1. Level Transmitter FLU-WIT-002:
 - a. Weight transmitter with integral display.
 - b. Refer to instrument data sheet for calibration range.
 - 2. Operator Workstation:
 - a. Lake Fort Smith WTP:
 - (1) Display range of 0-1600 lbs and 0-150 gallons.
 - (2) Low-low level alarm adjustable between 0-150 gallons initially set at 25 gallons.
 - (3) Low level warning adjustable between 0-150 gallons initially set at 40 gallons.
 - (4) High level warning adjustable between 0-150 gallons initially set at 100 gallons.
 - b. Lee Creek WTP:
 - (1) Display range of 0-1100 lbs and 0-100 gallons.
 - (2) Low-low level alarm adjustable between 0-100 gallons initially set at 15 gallons.
 - (3) Low level warning adjustable between 0-100 gallons initially set at 25 gallons.
 - (4) High level warning adjustable between 0-100 gallons initially set at 60 gallons.
- D. System Upsets and Procedures for Recovery:
 - 1. If the day tank weight signal is lost or out of range, the control system shall shut down all operating pumps and alarm the operator via the operator workstation.
 - 2. If a pump fails, the control system shall alarm the operator via the operator workstation.

3.06 FLUOSILICIC ACID METERING PUMPS:

- A. System Components and Functions:
 - 1. Fluosilicic Acid Metering Pump: FLU-MP-001.
 - 2. Fluosilicic Acid Metering Pump: FLU-MP-002.
- B. Description of Operations:
 - 1. The fluosilicic acid metering pump shall be capable of being controlled locally at the metering pump control panel or remotely at the operator workstation when the associated HAND/OFF/REMOTE switch is in REMOTE.
 - 2. Local Control:
 - a. When the associated selector switch is placed in HAND the pump shall start. The feed rate adjustment shall be controlled at the pump operator interface.
 - 3. Remote Control:
 - a. When the pump is in REMOTE control, starting, stopping, and feed rate adjustment shall be controlled remotely by the plant control system.
 - b. HMI screens shall be developed to allow the operator to select from two modes of operation.
 - c. Remote Manual Control Mode:
 - (1) Starting and stopping of the metering pump is initiated by the operator at the operator workstation.
 - (2) The operator shall set the feed rate in gallons per hour at the operator workstation.

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- d. Remote Automatic Control Mode:
 - (1) The operator shall set the dosing rate based upon milligrams per liter (mg/L) of fluoride at the operator workstation.
 - (2) The dosing rate shall be displayed on the operator workstation in units of mg/L as Fluoride (F).
 - (3) The operator shall enter at the operator workstation the solution concentration in units of percent for the fluosilicic acid supplied by the chemical supplier.
 - (4) The feed rate in gallons per day of the metering pump shall be calculated by multiplying the dosing rate by the total plant flow rate in MGD as measured by the existing flow transmitter (RWS-FIT-200 for the Lake Fort Smith WTP and WW_Total_RW_Flow_MGD for the Lee Creek WTP), multiplying by 1.05, and dividing by the solution concentration in decimal format.
 - (5) The resultant feed rate shall be used to control the speed (feed rate) of the metering pumps via a 4-20 mA signal.
 - (6) The metering pumps shall be capable of being rotated in a lead, lag fashion manually by the operator and automatically by the plant control system. Lead/Lag selections and a rotation timer shall be made available on the HMI screen for this function.
 - (7) If the Lead metering pump is operating at 100% speed and the dosing rate exceeds the feed rate capacity of a single metering pump the Lag pump shall be started and both metering pumps will modulate simultaneously using the PID algorithm to achieve the calculated feed rate.
 - (8) If the feed rate demand falls and both pumps are operating at or below 50% speed for a period of 5 minutes the Lead pump shall shut down and the Lag pump role will be shifted to Lead pump and continue to operate to achieve the calculated feed rate.
 - (9) The percent speed and time period values listed above shall be operator adjustable.
 - (10) Refer to System Upsets and Procedures for Recovery Section for additional programming requirements.
 - e. The feed rate of the metering pump shall be displayed on the operator workstation in units of gallons per day (gal/day).
 - f. The run status, fail status, and remote status shall be displayed on the operator workstation for the metering pump.
 - g. A day tank low level shutdown as measured by FLU-WIT-002 shall be programmed for the metering pump.
 - h. Feed rate for the pump shall be trended.
- C. Set Points and Ranges:
- 1. Fluosilicic Acid Metering Pumps:
 - a. Lake Fort Smith WTP feed rate range of 0-120 gal/day.
 - b. Lee Creek WTP feed rate range of 0-70 gal/day.
 - 2. Operator Workstation:
 - a. Lake Fort Smith WTP:
 - (1) Dosing rate range adjustable between 0-1.2 mg/L F.
 - (2) Fluosilicic Acid solution concentration adjustable between 0-100% initially set at 25%.
 - (3) Feed rate range of 0-120 gallons per day.

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- (4) Day Tank low level shutdown adjustable between 0-120 gallons initially set at 15 gallons.
- b. Lee Creek WTP:
 - (1) Dosing rate range adjustable between 0-1.2 mg/L F.
 - (2) Fluosilicic Acid solution concentration adjustable between 0-100% initially set at 25%.
 - (3) Feed rate range of 0-100 gallons per day.
 - (4) Day Tank low level shutdown adjustable between 0-80 gallons initially set at 10 gallons.
- D. System Upsets and Procedures for Recovery:
 - 1. System in Remote Automatic Control Mode:
 - a. If the primary flow signal is lost or out of range, the control system shall alarm the operator via the operator workstation. If the primary flow signal is restored, normal operation shall resume.
 - b. In the event that a lead metering pump becomes unavailable, fails to start, or drops off-line, the lag pump shall be automatically selected to operate as the lead pump.
 - c. If the day tank weight signal is lost or out of range, the control system shall shut down all operating pumps and alarm the operator via the operator workstation.

3.07 WATER QUALITY - FLUORIDE MONITORING:

- A. System Components and Functions:
 - 1. Fluoride Analyzer and Indicating Transmitter FLU-AIT-001.
 - a. Measures fluoride concentration levels in the finished water.
- B. Description of Operation:
 - 1. Fluoride Analysis:
 - a. The fluoride concentration of the finished water shall be measured by fluoride analyzer and indicating transmitter FLU-AIT-001.
 - b. The fluoride concentration shall be displayed on the operator workstation and high level warning, high-high level alarm, and loss of signal alarms shall be set.
 - c. The fluoride concentration levels shall be trended.
- C. Set Points and Ranges:
 - 1. Fluoride Transmitter FLU-AIT-001:
 - a. Fluoride transmitter with integral display.
 - b. Refer to Section 40 91 00 for calibration ranges.
 - 2. Operator Workstation:
 - a. Display range of 0-5 mg/L for FLU-AIT-001.
 - b. High level fluoride concentration warning adjustable between 0-2.0 mg/L initially set at 1.0 mg/L.
 - c. High-High level fluoride concentration alarm adjustable between 0-2.0 mg/L initially set at 1.5 mg/L.
- D. System Upsets and Procedures for Recovery:
 - 1. If the fluoride concentration level signal is lost or out of range, the control system shall shut down the fluoride metering pumps and alarm the operator via the operator workstation.
 - 2. If the fluoride concentration reaches the high-high level, the control system shall shut down the fluoride metering pumps and alarm the operator via the operator workstation.

SECTION 40 96 35 – PROCESS CONTROL SOFTWARE PROGRAMMING AND REPORTS: continued

3.08 FIELD QUALITY CONTROL:

- A. Field Testing:
 - 1. As specified in SECTION 40 90 00.
 - 2. A testing plan shall be developed and submitted for approval prior to testing of the control system.
 - 3. Each mode of operation shall be tested along with fault conditions for proper system response.
- B. Test Reports:
 - 1. Submit test reports as specified in DIVISION 01.
 - 2. Maintain a written record of all tests showing date, personnel making tests, equipment or material tested, tests performed, and results.

3.09 TRAINING:

- A. The System Integrator shall provide formal training for operators, maintenance and service personnel.
- B. The training session shall include classroom discussion on the theory of operation of the control system as well as maintenance and service methods for the system. Topics covered shall include functionality of the system, system navigation, data management and recommended backup procedures.
- C. Operator Training Sessions:
 - 1. Prior to the startup of the new control system a training session shall be provided for all operators. The training session shall clearly explain how to utilize the new system. HMI screens for the new system shall be presented and operators shall have the opportunity to utilize the new system in a demonstration mode and navigate all the screens. The training session shall also explain and demonstrate customized features such as report generation, alarm review and acknowledgment procedures.
- D. The Owner at their option shall be allowed to video record all training sessions for future reference.

END OF SECTION 40 96 35

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I/O LIST

| TAG NUMBER | ASSOCIATED PLC | FIELD DEVICE | DESCRIPTION | FUNCTION | TYPE | OUTPUT/INPUT (NORMAL STATE) | RANGE/ SET POINT | ENGINEERING UNIT | XMTR TYPE | POWER (SEE NOTE 1) | SPECIAL NOTES |
|----------------------------|----------------|--------------|--|---------------|------|-----------------------------|------------------|------------------|-----------|--------------------|---------------|
| FLUOR_ETHERNET_SWITCH_FAIL | FLU-PLC-001 | FLU-NSW-001 | NETWORK SWITCH FAIL | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_SURGE_SUPPRESS_FAIL | FLU-PLC-001 | FLU-LCP-001 | 120VAC SURGE SUPPRESSOR | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_120VAC_PLCPower_FAIL | FLU-PLC-001 | FLU-LCP-001 | 120VAC INPUT POWER | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_24DC_UPS_FAIL | FLU-PLC-001 | FLU-LCP-001 | 24VDC POWER SUPPLY/UPS | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_EYEWASH_ALARM | FLU-PLC-001 | FLU-FS-001 | EMERGENCY EYE WASH STATION FLOW | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_DAY_TANK_LEAK | FLU-PLC-001 | FLU-LS-001 | DAY TANK LEAK LEVEL SWITCH | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | 4 |
| FLUOR_BULK_TANK_LEVEL | FLU-PLC-001 | FLU-LIT-001 | FLUOROSILICIC ACID BULK TANK FLU-TNK-001 | LEVEL | AI | 4-20mA | 0-10 | FEET | 4-WIRE | SYSTEM | 2, 3, 4 |
| FLUOR_DAY_TNK_WEIGHT | FLU-PLC-001 | FLU-WIT-002 | FLUOROSILICIC ACID DAY TANK FLU-TNK-002 | WEIGHT | AI | 4-20mA | 0-3000 | LBS | 4-WIRE | SYSTEM | 3, 4 |
| FLUOR_XFER_PMP_RUNNING | FLU-PLC-001 | FLU-TP-001 | TRANSFER PUMP | RUN STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_XFER_PMP_FAIL | FLU-PLC-001 | FLU-TP-001 | TRANSFER PUMP | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_RUNNING | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | RUN STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_FAIL | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_AUTO | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | IN-AUTO | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_START | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | START/STOP | DO | N.O. CONTACT | N/A | N/A | N/A | FIELD | |
| FLUOR_METER_PMP1_FLOW | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | FLOW | AI | 4-20mA | | GPH | 2-WIRE | FIELD | 3 |
| FLUOR_METER_PMP1_SPEEDCTRL | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | SPEED CONTROL | AO | 4-20mA | 0 - 100 | % | N/A | SYSTEM | |
| FLUOR_METER_PMP2_RUNNING | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | RUN STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP2_FAIL | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP2_AUTO | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | IN-AUTO | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP2_START | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | START/STOP | DO | N.O. CONTACT | N/A | N/A | N/A | FIELD | |
| FLUOR_METER_PMP2_FLOW | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | FLOW | AI | 4-20mA | | GPH | 2-WIRE | FIELD | 3 |
| FLUOR_METER_PMP2_SPEEDCTRL | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | SPEED CONTROL | AO | 4-20mA | 0 - 100 | % | N/A | SYSTEM | |
| FLUOR_FORCED_DOOR_ALARM | FLU-PLC-001 | FLU-ACP-001 | SECURITY SYSTEM FORCED DOOR | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_DOOR_AJAR_ALARM | FLU-PLC-001 | FLU-ACP-001 | SECURITY SYSTEM DOOR AJAR | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_ANALYZER_INDICATION | FBS-PLC-001 | FLU-AIT-001 | PLANT FINISHED WATER POST 4MG CLEARWELL | FLUORIDE | AI | 4-20mA | 0 - 5 | mg/L | 4-WIRE | FIELD | |

NOTES:

1. "SYSTEM" - POWER FROM ASSOCIATED PANEL. "FIELD" - POWER FROM OTHER SOURCE INDICATED ELSEWHERE.
2. PROVIDE TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) FOR I/O POINT.
3. RANGE SHALL BE COORDINATED WITH THE EQUIPMENT SUPPLIER.
4. PROVIDE 24VDC POWER SOURCE FROM PLC PANEL FOR INSTRUMENT.
5. PROVIDE 120VAC POWER SOURCE FROM PLC PANEL FOR INSTRUMENT.

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I/O LIST

| TAG NUMBER | ASSOCIATED PLC | FIELD DEVICE | DESCRIPTION | FUNCTION | TYPE | OUTPUT/INPUT (NORMAL STATE) | RANGE/ SET POINT | ENGINEERING UNIT | XMTR TYPE | POWER (SEE NOTE 1) | SPECIAL NOTES |
|----------------------------|----------------|--------------|--|---------------|------|-----------------------------|------------------|------------------|-----------|--------------------|---------------|
| FLUOR_ETHERNET_SWITCH_FAIL | FLU-PLC-001 | FLU-NSW-001 | NETWORK SWITCH FAIL | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_SURGE_SUPPRESS_FAIL | FLU-PLC-001 | FLU-LCP-001 | 120VAC SURGE SUPPRESSOR | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_120VAC_PLCPower_FAIL | FLU-PLC-001 | FLU-LCP-001 | 120VAC INPUT POWER | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_24DC_UPS_FAIL | FLU-PLC-001 | FLU-LCP-001 | 24VDC POWER SUPPLY/UPS | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_EYEWASH_ALARM | FLU-PLC-001 | FLU-FS-001 | EMERGENCY EYE WASH STATION FLOW | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_DAY_TANK_LEAK | FLU-PLC-001 | FLU-LS-001 | DAY TANK LEAK LEVEL SWITCH | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | 4 |
| FLUOR_BULK_TANK_LEVEL | FLU-PLC-001 | FLU-LIT-001 | FLUOROSILICIC ACID BULK TANK FLU-TNK-001 | LEVEL | AI | 4-20mA | 0-10 | FEET | 4-WIRE | SYSTEM | 2, 3, 4 |
| FLUOR_DAY_TNK_WEIGHT | FLU-PLC-001 | FLU-WIT-002 | FLUOROSILICIC ACID DAY TANK FLU-TNK-002 | WEIGHT | AI | 4-20mA | 0-3000 | LBS | 4-WIRE | SYSTEM | 3, 4 |
| FLUOR_XFER_PMP_RUNNING | FLU-PLC-001 | FLU-TP-001 | TRANSFER PUMP | RUN STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_XFER_PMP_FAIL | FLU-PLC-001 | FLU-TP-001 | TRANSFER PUMP | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_RUNNING | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | RUN STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_FAIL | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_AUTO | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | IN-AUTO | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP1_START | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | START/STOP | DO | N.O. CONTACT | N/A | N/A | N/A | FIELD | |
| FLUOR_METER_PMP1_FLOW | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | FLOW | AI | 4-20mA | | GPH | 2-WIRE | FIELD | 3 |
| FLUOR_METER_PMP1_SPEEDCTRL | FLU-PLC-001 | FLU-MP-001 | METERING PUMP FLU-MP-001 | SPEED CONTROL | AO | 4-20mA | 0 - 100 | % | N/A | SYSTEM | |
| FLUOR_METER_PMP2_RUNNING | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | RUN STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP2_FAIL | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | FAIL STATUS | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP2_AUTO | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | IN-AUTO | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_METER_PMP2_START | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | START/STOP | DO | N.O. CONTACT | N/A | N/A | N/A | FIELD | |
| FLUOR_METER_PMP2_FLOW | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | FLOW | AI | 4-20mA | | GPH | 2-WIRE | FIELD | 3 |
| FLUOR_METER_PMP2_SPEEDCTRL | FLU-PLC-001 | FLU-MP-002 | METERING PUMP FLU-MP-002 | SPEED CONTROL | AO | 4-20mA | 0 - 100 | % | N/A | SYSTEM | |
| FLUOR_FORCED_DOOR_ALARM | FLU-PLC-001 | FLU-ACP-001 | SECURITY SYSTEM FORCED DOOR | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_DOOR_AJAR_ALARM | FLU-PLC-001 | FLU-ACP-001 | SECURITY SYSTEM DOOR AJAR | ALARM | DI | N.O. CONTACT | N/A | N/A | N/A | SYSTEM | |
| FLUOR_ANALYZER_INDICATION | FWPS-PLC-001 | FLU-AIT-001 | PLANT FINISHED WATER POST CLEARWELL | FLUORIDE | AI | 4-20mA | 0 - 5 | mg/L | 4-WIRE | FIELD | |

NOTES:

1. "SYSTEM" - POWER FROM ASSOCIATED PANEL. "FIELD" - POWER FROM OTHER SOURCE INDICATED ELSEWHERE.
2. PROVIDE TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) FOR I/O POINT.
3. RANGE SHALL BE COORDINATED WITH THE EQUIPMENT SUPPLIER.
4. PROVIDE 24VDC POWER SOURCE FROM PLC PANEL FOR INSTRUMENT.
5. PROVIDE 120VAC POWER SOURCE FROM PLC PANEL FOR INSTRUMENT.

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 463335 - CHEMICAL STORAGE TANKS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the design, fabrication, delivery, installation, and successful startup operation of one bulk storage tank and one day tank at both the Lake Fort Smith and Lee Creek water treatment plants for storing fluosilicic acid complete with all accessories and appurtenances as indicated. Day tanks shall be provided with scales and transmitter as specified in this Section.
 - 1. Fluosilicic Acid concentration of 20-25% (Also known as Hydrofluorosilicic Acid, Hydrofluosilicic Acid, or Fluorosilicic Acid).
 - 2. Furnish all special tools required for assembly and operation.
- B. Related Work Specified Elsewhere:
 - 1. Mechanical: DIVISION 25.
 - 2. Electrical: DIVISION 26.
 - 3. Instrumentation and Controls: DIVISION 40.

1.02 QUALITY ASSURANCE:

- A. References:
 - 1. Applicable Standards:
 - a. Anti-Friction Bearing Manufacturers Association (AFBMA).
 - b. American National Standards Institute (ANSI).
 - c. American Society of Mechanical Engineers (ASME):
 - (1) B16.5 – Pipe Flanges and Flanged Fittings.
 - d. American Society for Testing and Materials (ASTM):
 - (1) D1998 - Standard Specification for Polyethylene Upright Storage Tank.
 - e. Standards of the Hydraulic Institute.
- B. Tanks shall carry manufacturer's warranty for a minimum of ten years prorated after five years from the date of acceptance by Owner.
- C. Factory Testing:
 - 1. Manufacturer shall conduct shop tests as required to guarantee compliance with this Specification.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. All information shall be clearly marked showing the manufacturer's name, size, materials, options, etc., for all equipment intended for consideration. All information shall be submitted in a complete package from a single source which addresses each item of the specification and demonstrates adequate compliance. Specified requirements are listed below.
- C. Data to be submitted for the storage tank, tank accessories, includes, but is not limited to, the following:
 - 1. Manufacturer's name, size, material, and fittings.
 - 2. Protective coatings system (if applicable).
 - 3. General arrangements, dimensions, and mounting details.
 - 4. Product data and electrical diagrams for scales and associated transmitter.
 - 5. A schedule of maintenance requirements.
 - 6. Any special tools required for assembly and operation.
 - 7. Include a list of recommended spare parts along with prices and ordering information.

SECTION 463335 – CHEMICAL STORAGE TANKS: continued

8. All details for accessories including materials of construction and specific information that addresses specified criteria.
 9. Operations and maintenance manuals.
- 1.04 DELIVERY AND HANDLING:
- A. Delivery, storage, and handling shall be as specified in DIVISION 01 and shall conform to the following requirements:
 1. Ship equipment as completely assembled as is possible.
 2. Tag each item of equipment with contract number.
 3. Protect flanged and welded connections with suitable pipe and protection.
 4. Adequately seal all storage tank openings.
 5. Store and protect tank, tank accessories, and pumps in an environment to avoid damage or decay.
 6. Notify Engineer and Contractor 30 days prior to shipping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Tanks:
 1. Snyder Industries.
 2. Assmann Corporation of America.
 3. Poly Processing Company.
 4. Engineer-approved equal.
- B. Scales:
 1. Force Flow.

2.02 GENERAL DESIGN PARAMETERS:

- A. Maximum Air Temperature = 120°F; Minimum Outside Air Temperature = 0°F.
- B. Tanks shall be one-piece, molded and free from surface blemishes, cracks, pits, or holes.
- C. Sizes, accessories, openings and nozzle arrangements, construction materials, and physical dimensions for each tank are to be as indicated and as specified. Provide all items necessary for complete installation including, nuts, bolts, and gaskets suitable for intended service.
- D. Tanks shall be completely assembled before being shipped from factory. This includes all fittings, coatings, and finishes. Any parts or assemblies shipped loose to avoid damage during shipping shall be as fully assembled as possible to make field installation as easy as possible.
- E. Manufacturer shall assume all liability of the design for conditions specified.
- F. Tank wall thickness for a given hoop stress is to be calculated in accordance with ASTM D 1998. Tanks shall be designed using a hoop stress no greater than 600 psi. In NO case shall the tank thickness be less than design requirements per ASTM D 1998.
- G. Resin used shall be 100% virgin, UV-stabilized, metallocene high density crosslinked polyethylene (XLPE).
- H. Integrally molded fittings shall be XLPE. Other fittings shall be CPVC, polypropylene, or polyethylene.
- I. The fill downpipe shall be supported with a non-intrusive pipe support.
- J. Gaskets shall be compatible with chemical being stored as certified by the tank manufacturer. Wetted materials shall be EPDM or Viton GF.
- K. Flanged connections shall be standard 150-pound flat face type with bolt holes straddling the principle centerline of the vessel.

SECTION 463335 – CHEMICAL STORAGE TANKS: continued

- L. Tanks shall be designed and sealed by a Professional Engineer registered in the State of Arkansas.

2.03 CHEMICAL STORAGE TANKS:

- A. Lake Fort Smith Design Parameters:
 - 1. Number of tanks:
 - a. Bulk storage tank: One.
 - b. Day tank: One.
 - 2. The tanks shall have the following approximate diameters:
 - a. Bulk storage tank: 96 in.
 - b. Day tank: 35 in.
 - 3. Type: Cross-Linked Polyethylene (XLPE).
 - 4. Minimum usable working volume:
 - a. Bulk storage tanks: 3000 gal.
 - b. Day tank: 120 gal (maximum 150 gal).
- B. Lee Creek Design Parameters:
 - 1. Number of tanks:
 - a. Bulk storage tank: One.
 - b. Day tank: One.
 - 2. The tanks shall have the following approximate diameters:
 - a. Bulk storage tank: 90 in.
 - b. Day tank: 34 in.
 - 3. Type: Cross-Linked Polyethylene (XLPE).
 - 4. Minimum usable working volume:
 - a. Bulk storage tanks: 1800 gal.
 - b. Day tank: 70 gal (maximum 100 gal).
- C. Construction:
 - 1. Bulk Storage Tanks: Single wall, flat bottom.
 - 2. Day Tank: Double wall, flat bottom.
- D. Location:
 - 1. Bulk storage tanks: Outside.
 - 2. Day tank: Inside.
- E. Chemicals Stored: 20-25% Fluosilicic Acid, SG = 1.2.
- F. Designed for seismic and wind loads, typical for area.
- G. Tanks shall be constructed with a minimum specific gravity rating of 1.9.
- H. Heads:
 - 1. Top Head: The top head, regardless of shape, shall be able to support a single 250 pound load on a 4' x 4' area without damage and with maximum deflection of 1/2% of the tank's diameter at the area the load is applied.
 - 2. Flat Bottom Head: Shall be molded integrally with the shell wall.
 - a. Bottom shall not have center patch (from steady rest fixture).
- I. Fittings and Accessories:
 - 1. Manways: Manways shall be required on bulk storage tanks only. The closed top tanks shall be provided with a minimum 18-inch-diameter top access manway with cover.
 - 2. Lifting Lugs: Lifting lugs shall be provided for all tanks over 500 pounds in weight. Painted lugs are not acceptable. Lugs are to be stainless steel.
 - 3. Hold Down Lugs: Hold down lugs shall be required on all vertical flat bottom tanks. The design number and attachment of such lugs is the responsibility of the fabricator, based on the wind, seismic and other loads specified.

SECTION 463335 – CHEMICAL STORAGE TANKS: continued

4. Flanged Nozzles:
 - a. Compression molded or flanges cemented to pipe are prohibited.
 - b. Flange back shall be spot faces and smooth and parallel to the front face to produce a true bearing surface for bolt heads and nuts.
 - c. Flanges shall conform to ASME B16.5 150 pound drilling.
 - d. All fittings on tank walls shall be double-bolted encapsulated fittings with EPDM gaskets and 316 SS bolts unless other bolt materials are necessary to provide manufacturer's warranty. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. All fittings on tank top head shall be bulkhead fittings with EPDM gaskets.
5. Tank drain shall be full drain side, as indicated on the drawings.
6. Bulk tank connections as indicated in detail drawings:
 - a. One top access manway.
 - b. One fill drain nozzle flange.
 - c. One flanged inlet connection.
 - d. One tank vent connection. Vent to be sized by manufacturer to accommodate maximum fill and drain rates of 150 gpm.
 - e. One outlet connection.
 - f. One overflow connection.
 - g. One 6-inch flange connection for ultrasonic level transmitter on top. Connection shall be self-aligning to allow for proper instrument leveling.
 - (1) Shall be located a minimum of 1/6 of the tank diameter from outer tank wall.
 - (2) Shall be designed to allow for an instrument blocking distance of 12" between the instrument flange and maximum usable tank level.
 - (3) When a pipe nozzle extension is required to meet the blocking distance specified the pipe interior shall be smooth and not contain any edges or joints. To minimize disturbing factors, provide an angled socket edge of 45 degrees.
 - h. Additional tank connections as indicated on drawings.
7. Flexible Connectors shall be provided for the tank connections where indicated on Drawings.
 - a. All flexible connections shall be designed to prevent any stresses due to loading, unloading, or thermal expansions of the tank and piping.
8. Day tank fittings :
 - a. One flanged inlet connection.
 - b. One tank vent connection.
 - c. One overflow connection
 - d. One outlet connection for pump suction nearest the bottom of tank as allowed by manufacturer.
 - e. One level indicator.
 - f. And as indicated on drawings.
9. Access Ladder (Bulk Storage Tanks Only):
 - a. Access ladder shall comply with local building codes and OSHA standards.
 - b. Access ladder shall be constructed using suitable materials to resist corrosion from elements and chemical stored in tank.
10. Provide leak level switch for double wall day tanks as specified this section.

SECTION 463335 – CHEMICAL STORAGE TANKS: continued

- J. Identification:
1. Label permanently laminated to each tank with the following minimum information:
 - a. Material to be stored.
 - b. Capacity.
 - c. Date of manufacture.
 - d. Name of manufacturer.
 - e. Tag tank number as indicated on Drawings.
 - f. Made of material compatible with the chemical to be stored.

2.04 LEAK LEVEL SWITCH:

- A. Optical leak detection level switch.
- B. NEMA 6 polypropylene housing with 3/4-inch NPT mounting thread.
- C. Minimum accuracy to $\pm 1/16$ inch.
- D. Shall operate from 24Vdc.
- E. Provide normally open relay contact that closes when liquid is detected. Contact shall be rated a minimum of 1 Amp at 24Vdc.
- F. Provide with a minimum of 10-foot of cable and terminate in a tank mounted junction box.
 1. Junction box shall be NEMA 4X, 316 SS.
 2. Provide as manufactured by Flowline Inc, Model LO10 or engineer approved equal.

2.05 DAY TANK SCALE:

- A. Provide a scale for each day tank as specified.
 1. Maximum Capacities:
 - a. Day Tank Scale: [4,000 lbs.]
 2. Dimensions:
 - a. Scale platform shall be sized to accept the supplied tank.
 - b. [Day Tank Scale: [50 inches x 50 inches] (L x W).]
 - c. [Platform shall be a maximum of XX inches x XX inches (L x W)]
- B. Scales shall have a steel frame design with a coating system resistant to moisture, chemicals, abrasion, impact, and UV damage.
- C. The platform height shall not exceed 3.5 inches.
- D. Stainless-steel leveling feet shall be supplied with stainless-steel shear beam cells.
- E. A four-cell system is required for accurate reading so that off center loads may be placed anywhere on the base and still obtain an accurate reading.
- F. All mounting hardware shall be stainless steel.
- G. Transmitter:
 1. Provide a transmitter compatible with supplied load cell system.
 2. Transmitter shall provide an isolated 4-20 mA output signal proportional to tank weight, calibrated for [0 to 4,000 lbs.] of liquid volume (not including tare weight).
 3. Backlit LCD display and membrane keypad for display and configuration of the unit.
 4. Keypad shall provide all interfaces required for monitoring, calibration, tare, and diagnostic functions. Adjustments using DIP switches shall not be acceptable.
 5. Operating temperature range of 0 to 50°C.
 6. NEMA 4X enclosure.
 7. Powered by 120Vac, single phase, 60 hertz.
 8. [Provide Force Flow Solo G2 or Engineer approved equal.]

2.06 SURFACE PREPARATION AND PAINTING:

- A. Stainless steel surfaces shall not be painted.

SECTION 463335 – CHEMICAL STORAGE TANKS: continued

- B. Shall conform to SECTION 099000.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Special Contractor Installation Instructions:
 - 1. Manufacturer shall furnish each bidding contractor a listing of any special installation instructions required for overall system installation. It shall be the Contractor's responsibility to familiarize itself with any special installation requirements.
- B. All tank wall fittings shall be installed in the factory or in the field by the Manufacturer.
- C. Installation shall conform to Manufacturer's recommendations, installation manuals and shop drawings.
- D. Make all electrical, control, and instrumentation connections as required and according to Manufacturer's instructions.

3.02 MANUFACTURERS FIELD SERVICES:

- A. The services of a manufacturer's qualified technical representative (field personnel) shall be required at the site for startup service, and training of Owners staff for proper operation of system and as required.
- B. The manufacturer's field personnel shall demonstrate experience with installation, start-up, and operating of systems of comparable size, application, and complexity.
- C. The manufacturer's field personnel shall verify plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.
- D. In addition to the time necessary to complete the requirements established elsewhere in these specifications and the Contract Documents, the field personnel shall be present at the Project Site during the minimum times as follows:
 - 1. Minimum of two trips to the jobsite, not to exceed a total of two eight-hour working days for services as listed paragraph 3.01 above with the specific provisions as follows.
 - 2. Training shall include a minimum of two working days for field training of Owners Staff and shall generally include, but not be limited to, the following:
 - a. System operational theory and background.
 - b. Automatic control.
 - c. Manual control.
 - d. Required maintenance.
 - e. System troubleshooting.
 - 3. Contractor shall coordinate between manufacturer's representative, Owner, and Engineer to schedule startup and training services.

3.03 FIELD TESTING AND INSPECTIONS:

- A. Shall be as specified in DIVISION 01 and in paragraph 3.02 above.
- B. Conduct in the presence of Owner and/or Engineer.
- C. All testing and inspections shall be performed by the manufacturer's representative per the manufacturer's recommendations and requirements and as specified.
- D. Contractor shall submit a written report within seven working days of completion of the field testing and inspections to Engineer covering all testing and inspection items and including any recommendations and corrections made.

SECTION 463335 – CHEMICAL STORAGE TANKS: continued

3.04 WRITTEN TEST/INSPECTION REPORTS:

- A. Failure to provide written test/inspection reports within the time frame specified shall invalidate the entire test and/or inspection. Retesting/inspection shall be performed as specified for the original test/inspection and all costs, including but not limited to Owner and/or Engineer's labor and expenses shall be paid by Contractor.
- B. Testing/inspection reports shall include full documentation of the test/inspection performed; including, but not limited to:
 - 1. Schematic of test performed.
 - 2. Testing/inspection equipment and instrument model and calibration data.
 - 3. All data recorded during the test/inspection in the units listed within this specification and shown on the plans.
 - 4. Names of personnel present with an attendance sheet signed by the Owner, Engineer, Resident Project Representative, or designee.

END OF SECTION 463335

SECTION 463343 – FLUOSILICIC ACID FEED SYSTEM

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the design, fabrication, delivery, installation, and successful startup operation of one transfer pump and two chemical feed pumps at both the Lake Fort Smith and Lee Creek water treatment plants for feeding fluosilicic acid complete with all accessories and appurtenances as indicated.
 - 1. Fluosilicic Acid concentration of 20-25% (also known as Hydrofluorosilicic Acid, Fluorosilicic Acid, and Hydrofluosilicic Acid).
 - 2. Furnish all special tools required for assembly and operation.
- B. Related Work Specified Elsewhere:
 - 1. Mechanical: DIVISION 25.
 - 2. Electrical: DIVISION 26.
 - 3. Process Controls: DIVISION 40.

1.02 QUALITY ASSURANCE:

- A. References:
 - 1. Applicable Standards:
 - a. Anti-Friction Bearing Manufacturers Association (AFBMA).
 - b. American Gear Manufacturers Association (AGMA).
 - c. American National Standards Institute (ANSI).
 - d. American Society for Testing and Materials (ASTM):
 - e. Institute of Electrical and Electronic Engineers (IEEE).
 - f. National Electrical Manufacturers Association (NEMA).
 - g. National Electrical Code (NEC).
 - h. Standards of the Hydraulic Institute.
- B. Feed system shall be warranted as specified in DIVISION 01.
- C. Factory Testing:
 - 1. Manufacturer shall conduct shop tests as required to guarantee compliance with this Specification.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. All information shall be clearly marked showing the manufacturer's name, model number, materials, size, options, etc., for all equipment intended for consideration. All information shall be submitted in a complete package from a single source which addresses each item of the specification and demonstrates adequate compliance. Specified requirements are listed below.
- C. Data to be submitted for the pumps, pressure relief valves, pulsation dampeners, piping, and valves includes, but is not limited to, the following:
 - 1. Manufacturer's name, type, and model.
 - 2. Predicted performance curves including pump flow range (gallons per hour) and pump output pressure (psi).
 - 3. Net positive suction head requirement and maximum total pressure on the discharge.
 - 4. General arrangements, dimensions, and mounting details.
 - 5. A schedule of maintenance requirements.
 - 6. Any special tools required for assembly and operation.
 - 7. Include a list of recommended spare parts along with prices and ordering information.

SECTION 463343 – FLUOSILICIC ACID FEED SYSTEM: continued

8. All details for accessories including materials of construction, pressure ratings, and specific information that addresses specified criteria.
 9. Pipe material of construction and size (inside and outside diameter).
 10. Schematic and wiring diagrams. Differentiate between factory and field wiring.
 11. Electrical drawings including schematic wiring diagrams and process and instrumentation diagrams (P&ID). All diagrams shall be complete and have uniquely numbered terminals, wires, and devices.
 12. Catalog cut sheets on all electrical components.
 13. Operations and maintenance manuals.
- D. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.

1.04 DELIVERY AND HANDLING:

- A. Delivery, storage, and handling shall be as specified in DIVISION 01 and shall conform to the following requirements:
1. Ship equipment as completely assembled as is possible.
 2. Tag each item of equipment with contract number.
 3. Protect flanged and welded connections with suitable pipe and protection.
 4. Store and protect pumps in an environment to avoid damage or decay.
 5. Store products indoors or in weather protected area until installation. Protect from construction traffic and damage.
 6. Notify Engineer and Contractor 30 days prior to shipping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

1. Watson-Marlow.
2. Blue-White Industries.

2.02 GENERAL DESIGN PARAMETERS:

- A. Maximum Air Temperature = 120°F; Minimum Outside Air Temperature = 0°F.

2.03 CHEMICAL METERING PUMPS:

- A. General Requirements:
1. Pump shall be capable of pumping Fluosilicic Acid directly from the day tank to the injection point as indicated on the Drawing. Maximum injection pressure = 15 psi. Minimum injection pressure = 5 psi.
 2. All pumphead components in the fluid path must be NSF61 listed and shall be of materials specified by the manufacturer as compatible with the process fluid.
 3. The pump mechanism shall be sealed from direct contact with outside atmospheres and suitable for operation in ambient conditions of 40°F to 100°F without the use of heating or cooling devices.
 4. Pump shall have a minimum turndown ratio of 1000:1 with a minimum accuracy of ±1% full flow capacity over a 100% to 10% flow range with regard to reproducibility, repeatability and linearity when operating with water at constant suction and discharge pressures and at constant speed conditions.
 5. Noise level of installed pump shall not exceed 90 dBA weighted average measured five feet from the surface.

SECTION 463343 - FLUOSILICIC ACID FEED SYSTEM: continued

6. Skid-mounting of pump, pump isolation valves, relief valves, anti-siphon device, backpressure valve, and any other required accessories shall be allowed.
7. Provide flow monitoring device to detect flow from the metering pump. If loss of flow is detected, the alarm contact shall be closed.
- B. Description: Self-priming peristaltic metering pump.
- C. Peristaltic Metering Pumps:
 1. All materials used for the metering pumps and accessories shall be designed by the manufacturer to have the necessary strength, stability, stiffness and corrosion resistance for the intended service. All connections, foundation bolts, plates, nuts, washers and clamps shall be constructed of 316 stainless steel and neoprene to be corrosion resistant to the conditions of use.
 2. Pump shall be of the positive displacement peristaltic type utilizing a flexible tube. The tubing shall be in contact with the inside diameter of the track (housing). Suction and discharge shall be on the same side of the pump head. The tubing shall be replaceable with no disassembly of the pump head and without the use of tools. Each pump shall consist of track/pump head cover with safety lock-out switch, screw-down retainer mechanism, roller rotor assembly with integral variable speed drive. The lock-out switch shall render the drive inoperable when opened. The pump head shall be easily secured to the drive and be self-locating.
 3. Each pump shall be capable of self-priming when completely dry. The pump shall be capable of running dry without damaging effects to the pump or tubing. The pump shall require no check valves or diaphragms and shall not require any dynamic seals in contact with the process fluid. The process fluid shall only be in contact with the inside of the pump tubing.
 4. The manufacturer shall furnish the appropriate hose material for the chemicals to be pumped (e.g. extruded Marprene, Norprene, Tygothane, Neoprene, Silicone, PVC, or Viton) and size the tubing for the appropriate chemical feed rates.
 5. Tubing shall be certified to NSF Standard 61.
 6. Rotor assembly and track shall be a single, unbroken track with transparent removable cover.
 7. Rotor assembly shall contain twin roller arms located 180 degrees apart, for compressing roller for occlusion of the tube twice per rotor revolution. One roller shall at all times be fully engaged with the tubing providing complete compression to prevent backflow or siphoning.
 8. Motor and Drive System:
 - a. Factory installed totally enclosed system rated for washdown duty. NEMA 4X (IP66). Enclosure shall be corrosion resistant, suitable for the specified application.
 - b. Motor shall be a brushless DC motor with variable speed control.
 - c. System shall include motor overload protection.
 - d. Rated for 120Vac, single phase, 60 hertz power supply.
 - e. Control requirements shall be as specified this Section.
- D. Lake Fort Smith Design Parameters
 1. Number of Pumps: Two – Staged operation in Lead/Lag setup.
 2. Each pump shall be capable of pumping 20-25% Fluosilicic Acid at the following flow rates:
 - a. Minimum: 23 gpd.
 - b. Maximum: 118 gpd (combined maximum) and 83 gpd per metering pump.

SECTION 463343 – FLUOSILICIC ACID FEED SYSTEM: continued

- E. Lee Creek Design Parameters:
 - 1. Number of Pumps: Two – Staged operation in Lead/Lag setup.
 - 2. Each pump shall be capable of pumping 20-25% Fluosilicic Acid at the following flow rates:
 - a. Minimum: 14 gpd.
 - b. Maximum: 68 gpd (combined maximum) and 48 gpd per metering pump.
- F. Accessories:
 - 1. Pump mounting hardware to either wall or floor as required if not skid-mounted.
 - 2. Anti-siphon protection.
 - a. Anti-siphon device with diaphragm that is spring-loaded in the closed position must be installed on the discharge of the metering pump.
 - 3. Back pressure valve.
 - 4. Priming aid/line drain.
 - 5. Pressure relief valve.
 - 6. Calibration column.
 - 7. Y-strainer.
 - 8. Pulsation damper.
 - 9. Any other required piping, valves, fittings, and accessories for successful pump operation.
- G. Power:
 - 1. Powered from 120Vac.
 - 2. Provide with factory attached cord.
 - 3. Power cord shall be prewired to skid mounted termination enclosure using terminal connections.
- H. Controls:
 - 1. Pump mounted user interface with LCD display.
 - a. Shall provide control and status display for the pump.
 - b. Shall provide for selection of manual or analog control of the metering pump.
 - c. Shall allow for manual setting of pump output in manual mode.
 - d. Shall display metered output in units of gallons per hour.
 - 2. Pump settings and mode of operation shall not be affected by loss of power.
 - 3. Provide indicating lights for pump status and failure alarms.
 - 4. The following outputs shall be provided from the metering pump controller to the PLC.
 - a. Pump Running status – N.O. dry contact, closed on run.
 - b. Pump Fail status – N.O. dry contact, closed on fail.
 - c. In-Auto Mode – N.O. dry contact, closed when auto mode is selected.
 - 5. The following analog signals shall be provided to each metering pump controller from the plant control system.
 - a. Metering Pump Feed Rate Adjustment (4-20mA).
 - 6. The metering pump shall provide a 4-20mA output signal for actual flow rate monitoring.
- I. Pump Control Cables:
 - 1. Pre-assembled pump control cables shall be supplied as part of the equipment package.
 - 2. One end shall include the factory connectors required to connect supplied cable to pump mounted plugs. The opposite end shall be hard wired to the skid mounted termination enclosure. Provide cord grips as required to maintain the NEMA rating of the termination enclosure.
 - 3. Pump cable quantities shall be as required to perform the specified control and monitoring functions.

SECTION 463343 - FLUOSILICIC ACID FEED SYSTEM: continued

- J. Termination Enclosure:
1. The equipment shall be supplied with a skid mounted NEMA 4X 316 SS corrosion resistant termination enclosure to facilitate all interconnections between the skid and field connections.
 - a. The enclosure shall include a hinged, lockable door, with quarter turn or latching style mechanisms.
 - b. Provide a corrosion resistant back panel for mounting specified components.
 2. As minimum the enclosure shall provide a main circuit breaker for incoming power and the necessary distribution circuit breakers to provide individual overcurrent protection of each pump on the skid. Additional circuit breakers shall be provided if required for additional skid mounted equipment.
 3. All connections shall pre-wired at the factory and be made using terminal blocks.
 4. Power, control, and instrument cables shall be arranged and terminated within the enclosure as to minimize interference between signal and power cables.
 5. All terminal blocks shall be labeled. Provide interconnection diagrams as required.
 6. All components shall conform to Section 409513 - Process Control Panels and Hardware.

2.04 TRANSFER PUMPS:

- A. Pump shall be a peristaltic pump.
- B. Peristaltic pumps shall be designed to pump fluid by alternately compressing and relaxing a resilient hose by compressing the hose between the inner wall of the pump housing and the compression shoes on a rotating rotor. The pump shall have no internal seats, seals, or valves. The pump shall be capable of running dry without damage to any pump components. The pumping rate shall be directly proportional to the pump speed.
- C. Acceptable Manufacturers:
 1. Bredel.
 2. Finish Thompson.
 3. Engineer-approved equal.
- D. Design Parameters:
 1. Pump shall be capable of pumping 20-25% Fluosilicic Acid at a flow rate of 8 gpm at Lake Fort Smith and 4 gpm at Lee Creek at a pressure of 10 psi.
 2. The manufacturer shall furnish all metering pump system equipment to complete a properly functioning, integrated package as specified. The system shall be factory-assembled to the maximum extent practical. Factory assembly shall include all pumps, motors, bases, and appurtenant valves and fittings. Any component parts not pre-assembled due to packaging and shipping concerns shall be identified and clearly labeled. No field welding will be allowed.
 3. All materials used for the metering pumps and accessories shall be designed by the manufacturer to have the necessary strength, stability, stiffness, and corrosion resistance for the intended service. All connections, foundation bolts, plates, nuts, washers and clamps shall be constructed of 316 stainless steel and neoprene to be resistant to the conditions of use.
 4. The circular pump housing shall be constructed of PVDF or engineer-approved equal that is chemically compatible and shall be free of any obstructions or rough surfaces. The interior of the housing shall be ground smooth and painted to provide a smooth and even surface for the pump house. The housing shall not have been repaired by welding or patching. The housing shall surround the rotor and pump hose and serve as a reservoir for the liquid lubricant. An oil drain port shall be provided at the bottom of the housing. The housing and liquid lubricant shall be sealed with a synthetic rubber O-ring between

SECTION 463343 – FLUOSILICIC ACID FEED SYSTEM: continued

the housing flange and the cover plate. The housing shall be equipped with a flanged inlet and outlet port for connection to external piping.

5. The pump rotor shall be constructed of cast iron and shall fit within the pump housing. Two rotor shoes shall be mounted to the rotor at a 180 degree angle to each other. Each of the shoes shall be connected to the rotor with a single bolt for easy removal. A one-piece bushing shall be provided to transmit the full torque of the drive to the rotor. The rotor shall be designed to run in a continuous sealed oil bath.
 6. The pumping hose shall be a single piece heavy duty Buna. The hose shall be designed to be capable of continuous cycles of compression and relaxation between the rotor shoes and the pump housing without shrinking, stretching, or cracking. The hose shall be of thick wall construction to cushion large or abrasive particles.
 7. The pump cover shall be constructed of a single circular aluminum plate. The cover shall bolt directly to the housing flange for easy removal and inspection. If required, the plate shall be reinforced with structural steel members to limit deflection. The cover shall be equipped with a clear PMMA inspection port, clear oil level gauge, and oil filling port.
- E. Pump Motor:
1. Maximum motor horsepower of 2 horsepower.
 2. 480V, 3-phase, 60-hertz.
 3. Totally enclosed fan cooled (TEFC) enclosure.
 4. Service factor of 1.15.
 5. Mil-chemical duty.
 6. Maximum motor speed of 1800 rpm.
- F. Accessories:
1. The entire pump assembly, including pump, motor, disconnect switch, control station, and speed reducer shall be mounted on a common baseplate that is compatible with fluosilicic acid. The base plate shall be designed for the full torque of the drive and shall be free from misalignment. The base plate shall be equipped with holes for anchor bolts.
 2. An air chamber type pulsation dampener shall be provided on each pump discharge.
 - a. Pulsation dampener shall be constructed of polypropylene, EPDM, or other materials suitable for contact with the indicated chemical.
 - b. Shall have a minimum capacity of 5 gallons.
 - c. Shall be equipped with gauge and fitting/valve for filling with air or nitrogen to required pressure as recommended by pump manufacturer.
 3. Pressure Relief:
 - a. Provide pressure relief valve for each pump, factory set at 30 psi and adjustable in the field.
 - b. Size valve to pass 100 percent of the rated flow for each pump at the set pressure.
 - c. Valve construction shall be CPVC with EPDM seals.
 - d. Provide NPT ends for valves less than 4 inches and flanged ends for valves 4 inches or larger.
 - e. Provide right angle type valve.
 - f. Provide valve rated for 150 psig at 100°F.
 - g. Provide valves that automatically close after high pressure has passed and are rated for more than 500 cycles per year.
 4. Provide a NEMA 4X, 316 SS disconnect and local control station for control of the pump. Equipment shall conform to DIVISION 26 specifications.

2.05 Y-STRAINER:

- A. Design Parameters:

SECTION 463343 - FLUOSILICIC ACID FEED SYSTEM: continued

1. Acceptable Manufacturers:
 - a. Hayward.
2. Style: Duplex.
3. Size: 1 inch.
4. Material of Construction:
 - a. Housing: PVC.
 - b. Basket: PVC.
5. Connection Type: True Union.
6. Basket Size: 1/32 inch Mesh.
7. Provide for cleaning without removal from pipe.

2.06 SPARE PARTS

- A. Spare parts and special tools required for disassembly shall be provided.
- B. The following spare parts shall be provided:
 1. Supply Two (2) tube elements of the specified installed size per pump.
 2. One (1) pump head per pump type and size.

2.07 SURFACE PREPARATION AND PAINTING:

- A. Stainless steel surfaces shall not be painted.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Special Contractor Installation Instructions:
 1. Manufacturer shall furnish each bidding contractor a listing of any special installation instructions required for overall system installation. It shall be the Contractor's responsibility to familiarize itself with any special installation requirements.
- B. Installation shall conform to Manufacturer's recommendations, installation manuals and shop drawings.
- C. Make all electrical, control, and instrumentation connections as required and according to Manufacturer's instructions.

3.02 MANUFACTURERS FIELD SERVICES:

- A. The services of a manufacturer's qualified technical representative (field personnel) shall be required at the site for startup service, and training of Owners staff for proper operation of system and as required.
- B. The manufacturer's field personnel shall demonstrate experience with installation, start-up, and operating of systems of comparable size, application, and complexity.
- C. The manufacturer's field personnel shall verify all skid mounted equipment and piping connections, external connections, and applicable ancillary equipment. A verification of proper installation certificate will be supplied when equipment passes installation checklist.
- D. In addition to the time necessary to complete the requirements established elsewhere in these specifications and the Contract Documents, the field personnel shall be present at the Project Site during the minimum times as follows:
 1. Minimum of two trips to the jobsite, not to exceed a total of five eight-hour working days for services as listed paragraph 3.01 above with the specific provisions as follows.
 2. Training shall include a minimum of two working days for field training of Owners Staff and shall generally include, but not be limited to, the following:

SECTION 463343 – FLUOSILICIC ACID FEED SYSTEM: continued

- a. System operational theory and background.
 - b. Automatic control.
 - c. Manual control.
 - d. Required maintenance.
 - e. System troubleshooting.
3. Contractor shall coordinate between manufacturer's representative, Owner, and Engineer to schedule startup and training services.
- 3.03 FIELD TESTING AND INSPECTIONS:
- A. Shall be as specified in DIVISION 01 and in paragraph 3.02 above.
 - B. Conduct in the presence of Owner and/or Engineer.
 - C. All testing and inspections shall be performed by the manufacturer's representative per the manufacturer's recommendations and requirements and as specified.
 - D. Contractor shall submit a written report within seven working days of completion of the field testing and inspections to Engineer covering all testing and inspection items and including any recommendations and corrections made.
- 3.04 WRITTEN TEST/INSPECTION REPORTS:
- A. Failure to provide written test/inspection reports within the time frame specified shall invalidate the entire test and/or inspection. Retesting/inspection shall be performed as specified for the original test/inspection and all costs, including but not limited to Owner and/or Engineer's labor and expenses shall be paid by Contractor.
 - B. Testing/inspection reports shall include full documentation of the test/inspection performed; including, but not limited to:
 1. Schematic of test performed.
 2. Testing/inspection equipment and instrument model and calibration data.
 3. All data recorded during the test/inspection in the units listed within this specification and shown on the plans.
 4. Names of personnel present with an attendance sheet signed by the Owner, Engineer, Resident Project Representative, or designee.

END OF SECTION 463343



Burns & McDonnell World Headquarters
9400 Ward Parkway
Kansas City, MO 64114
Phone: 816-333-9400
Fax: 816-333-3690
www.burnsmcd.com

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